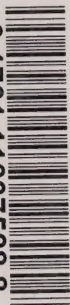


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Canada. Commission Appointed
to Delimit the Boundary
Between the Provinces of
Alberta and British Columbia.
Report. Pt. 4.

Commissioners

R. Thistlethwaite, D.L.S., A.L.S., B.C.L.S.
For the Government of Canada

J. H. Holloway, D.L.S., A.L.S.
For the Government of Alberta

G. S. Andrews, B.C.L.S.
For the Government of British Columbia

Report of the Commission
Appointed to Delimit the Boundary
between the Provinces of
Alberta and British Columbia

PART IV

1950 to 1953

Latitude 57°26'40"25 Northerly

Office of the Surveyor General
Ottawa, 1955



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Canada. Boundary between the Provinces of Alberta
and British Columbia, Commission appointed
to delimit the

Commissioners

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Ottawa, 1955

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OTTAWA. 1955

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OTTAWA, ONTARIO
FEBRUARY 7, 1955.

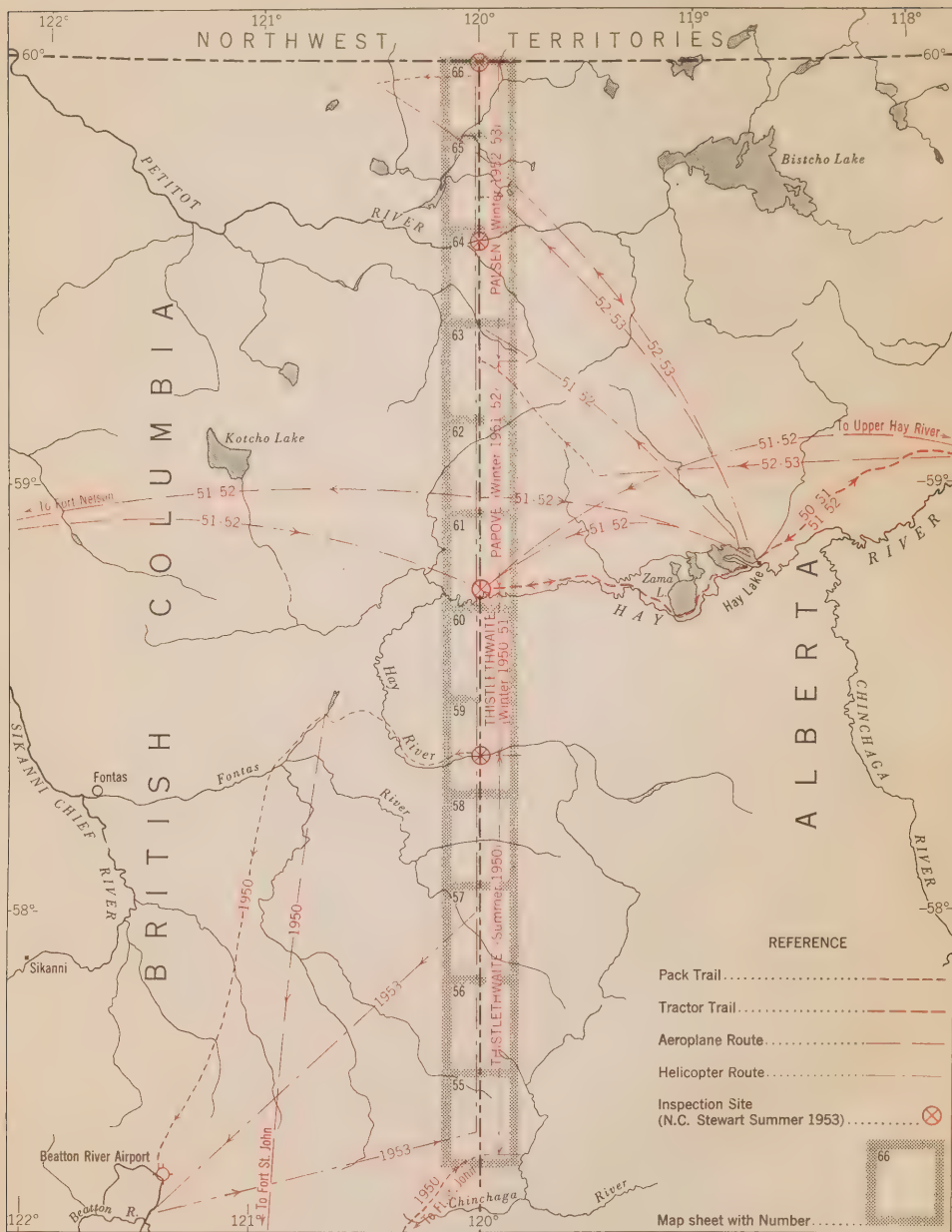
TO THE HONOURABLE GEORGE PRUDHAM, M.P., MINISTER OF MINES AND
TECHNICAL SURVEYS, OTTAWA; THE HONOURABLE IVAN CASEY, M.L.A.,
MINISTER OF LANDS AND FORESTS, EDMONTON; THE HONOURABLE R. E.
SOMMERS, MINISTER OF LANDS AND FORESTS, VICTORIA.

Your Commissioners, R. Thistlethwaite, D.L.S., A.L.S., B.C.L.S., Surveyor General of Canada, representing the Government of Canada, J. H. Holloway, D.L.S., A.L.S., formerly Director of Surveys for Alberta, representing the Government of Alberta, and G. S. Andrews, B.C.L.S., Surveyor General of British Columbia, representing the Government of British Columbia, have the honour to present Part IV of the report of the Commission on the survey of the Alberta-British Columbia Boundary. Part IV is the final report covering the period February, 1950, to April, 1953, when the survey was completed from latitude $57^{\circ}26'40''25$ on the one hundred and twentieth meridian to the latter's intersection with the sixtieth parallel of north latitude. Accompanying it is an atlas of 12 map sheets, No. 55 to 66 inclusive.

R. THISTLETHWAITE	} <i>Commissioners</i>
J. H. HOLLOWAY	
G. S. ANDREWS	

KEY MAP

SHOWING PROGRESS BY SEASONS AND TRANSPORTATION ROUTES
WITH MAP SHEET INDEX



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CHAPTER I

INTRODUCTION

The boundary between the Provinces of Alberta and British Columbia is defined in the Imperial Act 29 and 30 Victoria, Chapter 67, as a line extending "from the Boundary of the United States northwards by the Rocky Mountains and the One Hundred and Twentieth Meridian of West Longitude" to the 60th parallel of north latitude.

The survey and demarcation of this line on the ground was begun in 1913 by a boundary commission consisting of Messrs. J. N. Wallace, D.L.S., representing the Government of Canada, R. W. Cautley, D. and A.L.S., representing the Government of Alberta, and A. O. Wheeler, B.C.L.S., representing the Government of British Columbia. The operations of that Commission continued until 1924, by which time the boundary had been surveyed and monumented along the watershed line of the Rocky Mountains and northerly along the 120th meridian to latitude $57^{\circ}26'40''.25$. The survey was discontinued at that point, as there was no practical necessity at the time for extending the line farther. A detailed account of these survey operations is contained in the three-volume report and accompanying atlases which were prepared by the Commission and published by the Office of the Surveyor General of Canada as the work progressed. The boundary thus marked on the ground was assented to by the governments of Alberta and British Columbia in 1931 and confirmed by Act of Parliament, 22-23 George V, Ch. 5, The Alberta-British Columbia Boundary Act, 1932, passed on April 4 of that year.

During the following 25 years there was no pressing necessity for continuation of the boundary survey, but by 1949 two new developments made it a matter of considerable urgency. One was the undertaking by the Government of Alberta of a province-wide program of aerial mapping in connection with which it was found that the number of ground control points in the north-western part of the province was inadequate to permit accurate plotting of topographical details from the aerial photographs; the other was the rapid extension of petroleum exploration into the northwesterly part of the province and beyond into the Northwest Territories and northeastern British Columbia. As far as Alberta was concerned, further demarcation of the boundary would provide the ground control points required for the aerial mapping work. It would also define on the ground the limit of jurisdiction between Alberta and British Columbia with respect to petroleum exploration.

For these reasons it was agreed in 1949 by the three governments concerned that the unsurveyed portions of the Alberta-British Columbia boundary should be surveyed as soon as possible. Arrangements were accordingly made for the appointment of a new Alberta-British Columbia Boundary Commission consisting of the chief legal survey officers in the employ of each of the governments concerned. Copies of the orders in council by which the members of the Commission were appointed and which set out the functions of the Commission and the agreed division of costs of the survey follow.

"R. A. PENNINGTON"
Deputy Provincial Secretary

Certified Copy of a Minute of the Honourable the Executive Council,
Approved by His Honour the Administrator on the 5th day of November,
A.D. 1949.

2449

To His Honour the Administrator in Council:

The undersigned has the honour to report

THAT the Surveyor General of Dominion lands and the Director of Surveys for the Province of Alberta, have requested that the unsurveyed portion of the boundary between the Province of British Columbia and Alberta be surveyed.

THAT by Order-in-Council 1718, approved the 30th day of April 1918, authority was granted the Commission appointed to perform a joint survey of the boundary line between the Provinces aforesaid.

THAT by Order-in-Council 1051, approved the 1st day of August 1913, Mr. Arthur O. Wheeler, British Columbia Land Surveyor was appointed Boundary Commissioner to represent the Province of British Columbia upon the joint survey aforesaid.

THAT the said Arthur O. Wheeler is deceased.

THAT under authority of Chapter 8 of the Statutes of British Columbia 1931, the boundary line extending from the International Boundary on the forty-ninth parallel of north latitude northerly to a point on the one hundred and twentieth meridian of west longitude in or about latitude north fifty-seven degrees, twenty-six minutes, and forty and twenty-five one-hundredths seconds was confirmed.

AND TO RECOMMEND:

THAT Order-in-Council 1051, approved the 1st day of August 1913, be rescinded.

AND FURTHER TO RECOMMEND THAT Norman Charles Stewart, British Columbia Land Surveyor and Dominion Land Surveyor of Rural Route No. 1, Langford, B.C., be appointed Boundary Commissioner to represent the Province of British Columbia upon the joint survey of the aforementioned.

AND FURTHER TO RECOMMEND THAT certified copies of this minute, if approved, be furnished Mr. B. W. Waugh, Surveyor-General, Department of Mines and Resources, Ottawa, Canada, and to Mr. N. C. Stewart, R.R. 1, Langford, B.C.

Dated this 4th day of November, A.D. 1949

"GEO. S. PEARSON"
Acting Minister of Lands and Forests

Approved this 4th day of November, A.D. 1949.

"BYRON I. JOHNSON"
Presiding Member of the Executive Council

Certified Copy of Order No. 1392/49 of the Executive Council of the
Province of Alberta

O.C. 1392/49

Approved and Ordered,

(Signed) J. C. BOWEN
Lieutenant Governor

Edmonton, Monday, November 21st, 1949.

The Executive Council has had under consideration the report of the Honourable the Minister of Public Works, dated November 18th, 1949, stating that:

WHEREAS that portion of the interprovincial boundary line between the Provinces of Alberta and British Columbia from the North boundary of Township Ninety-seven (97) to the north-westerly corner of the Province of Alberta has not been surveyed and marked on the ground; and

WHEREAS it is desirable that the aforesaid portion of the said boundary line be surveyed and marked on the ground particularly for the immediate purposes of providing control points for aerial photographic mapping and defining the limits of provincial jurisdiction with respect to petroleum and natural gas development in the north-westerly part of the Province; and

WHEREAS it appears fair and reasonable that the costs of the said boundary survey should be apportioned so as to be borne one-third by the Province of Alberta, one-third by the Province of British Columbia, and one-third by the Dominion of Canada; and

WHEREAS the Alberta-British Columbia Boundary Commission, which was established in 1913 to take charge of the survey of the said interprovincial boundary line has not been dissolved and it is now desirable that a Commissioner for Alberta, succeeding Richard William Cautley (now retired), be appointed thereto;

THEREFORE, upon the recommendation of the Honourable the Minister of Public Works, the Executive Council advises:

1. THAT the Government of Alberta Agrees to participate in completing the survey and demarcation of the said interprovincial boundary line;
2. THAT one-third of the costs of the said survey shall be borne by the Province of Alberta;
3. THAT JOHN HUBERT HOLLOWAY, Director of Surveys, Department of Public Works, be and he is hereby appointed as Boundary Commissioner, representing the Province of Alberta on the Alberta-British Columbia Boundary Commission.

(Signed) ERNEST C. MANNING
Chairman

Certified Copy of a Minute of a Meeting of the Committee of the
Privy Council, Approved by His Excellency the Governor General on
The 14th of February, 1950.

P.C. 691

The Committee of the Privy Council have had before them a report dated February 9, 1950, from the Minister of Mines and Technical Surveys, representing:

That by authority of Order in Council P.C. 337, dated the 18th day of February, 1913, and Executive Orders of the Provinces of Alberta and British Columbia, dated the 16th day of June and the 11th day of July, 1913, respectively, the survey of the boundary line between the Provinces of Alberta and British Columbia was undertaken;

That under these authorities the survey has been completed from the International Boundary Line with the United States of America to a point on the 120th Meridian about north latitude 57°26'40"25;

That under the above arrangement Canada has paid one-third of the costs of the survey;

That the Governments of the Provinces of Alberta and British Columbia now advise that for administrative purposes the boundary line between these two Provinces should be completed; and

That by Executive Orders of the Provinces of Alberta and British Columbia, John Hubert Holloway and Norman Charles Stewart, representative of the respective Provinces, have been nominated to represent their Provinces as Boundary Commissioners.

The Committee, therefore, on the recommendation of the Minister of Mines and Technical Surveys, advise that authority be granted to establish a Commission to be known as the Alberta-British Columbia Boundary Commission consisting of Bruce Wallace Waugh, Surveyor General of Dominion Lands, who shall be Chairman; John Hubert Holloway, Director of Surveys, Department of Public Works, of the Province of Alberta; and Norman Charles Stewart, British Columbia Land Surveyor, with authority to issue instructions for and direct the execution of all necessary surveys including the employment of personnel and purchase of equipment and supplies required to undertake the survey of the remainder of the boundary line between the Provinces of Alberta and British Columbia, Canada to pay one-third of the cost incurred by this Commission to be chargeable against Legal Surveys appropriation.

The Committee further advise that the report on the said surveys be submitted by the said Alberta-British Columbia Boundary Commission to the Parliament of Canada and the Governments of the Provinces of Alberta and British Columbia.

(Signed) N. A. ROBERTSON

Clerk of the Privy Council

The Honourable

The Minister of Mines and Technical Surveys

COMMISSION

appointing

BRUCE WALLACE WAUGH,
JOHN HUBERT HOLLOWAY and
NORMAN CHARLES STEWART,

Commissioners of the Alberta-
British Columbia Boundary Commission

T. RINFRET

*Deputy Governor General
Canada*

THE GREAT SEAL
OF
CANADA

GEORGE THE SIXTH, by the Grace of God,
of Great Britain, Ireland and the British Dominions
beyond the Seas KING, Defender of the Faith.

TO BRUCE WALLACE WAUGH, Esquire,
Surveyor-General of Dominion Lands; JOHN
HUBERT HOLLOWAY, Esquire, Director of
Surveys, Department of Public Works of the
Province of Alberta; and NORMAN CHARLES
STEWART, Esquire, British Columbia Land
Surveyor,

F. P. VARCOE,
*Deputy Attorney General,
Canada*

GREETING:

KNOW YOU, that reposing trust and confidence in your loyalty, integrity and ability, we have constituted and appointed, and We do hereby constitute and appoint you the said BRUCE WALLACE WAUGH, you the said JOHN HUBERT HOLLOWAY, and you the said NORMAN CHARLES STEWART, to be Commissioners of the Alberta-British Columbia Boundary Commission.

TO HAVE, hold, exercise and enjoy the said office of Commissioners of the Alberta-British Columbia Boundary Commission unto you the said BRUCE WALLACE WAUGH, you the said JOHN HUBERT HOLLOWAY and you the said NORMAN CHARLES STEWART, with all and every the powers, rights, authority, privileges, profits, emoluments and advantages unto the said office of right and by Law appertaining during Our pleasure.

And We do further appoint you the said BRUCE WALLACE WAUGH to be Chairman of Our said Commission.

IN TESTIMONY WHEREOF We have caused these Our Letters to be made Patent and the Great Seal of Canada to be hereunto affixed.

WITNESS; Our Right Trusty and Well-beloved Counsellor the Right Honourable THIBAUDEAU RINFRET, a Member of Our Most Honourable Privy Council, Chief Justice of Canada and Deputy of Our Right Trusty and Well-beloved Cousin, Harold Rupert Leofric George, Viscount Alexander of Tunis, Knight of Our Most Noble Order of the Garter, Knight Grand Cross of Our Most Honourable Order of the Bath, Knight Grand Cross of Our Most Distinguished Order of Saint Michael and Saint George, Companion of Our Most Exalted Order of the Star of India, Companion of Our Distinguished Service Order, upon whom has been conferred the Decoration of the Military Cross, Field Marshal in Our Army, Governor General and Commander-in-Chief of Canada.

AT OUR GOVERNMENT HOUSE, in Our City of Ottawa, this Fourteenth day of February in the year of Our Lord One Thousand Nine Hundred and Fifty and in the Fourteenth year of Our Reign.

By Command,

W. P. F. O'MEARA

Acting Under Secretary of State

In the spring of 1952, Mr. Stewart, having retired from the service of the British Columbia government, resigned as a member of the Commission, and his successor, Lieut. Col. G. S. Andrews, was appointed by the following orders in council:

" THAT by Order-in-Council No. 1015, approved the 17th day of July, 1943, a Commission was established known as the British Columbia-Yukon-Northwest Territories Boundary Commission, consisting of the Surveyor-General of the Dominion of Canada and the Surveyor-General of British Columbia.

THAT by Order-in-Council No. 19, approved the 3rd day of January, 1947, Norman Charles Stewart, Surveyor-General of British Columbia, was appointed a member of the said Commission in place of the former Surveyor-General.

THAT Order-in-Council No. 2449, approved the 5th day of November, 1949, authorized the appointment of Norman Charles Stewart, British Columbia Land Surveyor and Dominion Land Surveyor, as Boundary Commissioner to represent the Province of British Columbia upon the joint survey of the boundary between the Provinces of British Columbia and Alberta.

THAT the said Norman Charles Stewart has tendered his resignation from both Commissions.

AND TO RECOMMEND THAT Lieutenant-Colonel Gerald Smedley Andrews, M.B.E., B.C.L.S., P. Eng., Surveyor-General for British Columbia, be appointed in the place of Norman Charles Stewart on the said Commissions.

DATED this 19th day of May A.D. 1952.

"E. T. KENNEY"
Minister of Lands and Forests

APPROVED this 19th day of May A.D. 1952.

"G. S. WISMER"
Presiding Member of the Executive Council"

P. C. 2616

Privy Council
Canada

AT THE GOVERNMENT HOUSE AT OTTAWA
TUESDAY, the 6th day of May, 1952.

PRESENT

HIS EXCELLENCY

THE GOVERNOR GENERAL IN COUNCIL:

His Excellency the Governor General in Council, on the recommendation of the Minister of Mines and Technical Surveys, is pleased to appoint and doth hereby appoint, effective April 17th, 1952, Lieutenant-Colonel Gerald Smedley Andrews, M.B.E., B.C.L.S., P. Eng., Surveyor General for British Columbia, as the representative of the Province of British Columbia on the Alberta-British Columbia Boundary Commission established by Order in Council P.C. 691 of 14th February, 1950, and on the British Columbia-Yukon-Northwest Territories Boundary Commission established by Order in Council P.C. 5355 of 5th July, 1943, as amended by Order in Council P.C. 4895 of 28th November, 1946, in the place of Norman Charles Stewart, Esquire, resigned.

"G. A. ROBERTSON"
Clerk of the Privy Council"

Mr. Waugh retired from the service of the Canadian Government in September, 1953, and was succeeded as Surveyor General and Chairman of the Commission by Mr. R. Thistlethwaite, D.L.S., B.C.L.S. and A.L.S. The following Commission was issued in connection with Mr. Thistlethwaite's appointment to the chairmanship:

COMMISSION

appointing

ROBERT THISTLETHWAITE,
ESQUIRE,

Chairman of the Alberta-
British Columbia Boundary Commission

DATED..... 24th September, 1953.

RECORDED..... 14th January, 1954.

Film 1

Document 50

"D. J. SHUTTLEWORTH"

For Deputy Registrar General of Canada.

Refer. No. 142067

"Vincent Massey"

C A N A D A

THE GREAT SEAL
OF
CANADA

"PAUL FONTAINE"
for Deputy Attorney General
CANADA

ELIZABETH THE SECOND, by the Grace of
God of the United Kingdom, Canada and Her
other Realms and Territories Queen, Head of the
Commonwealth, Defender of the Faith.

TO ROBERT THISTLETHWAITE, ESQUIRE, Surveyor General of Canada, of the City of Ottawa,
in the Province of Ontario,

GREETING:—

KNOW YOU, that reposing trust and confidence in your loyalty, integrity, and ability, We
have constituted and appointed, and We do hereby constitute and appoint you the said ROBERT
THISTLETHWAITE to be Chairman of the Alberta-British Columbia Boundary Commission.

TO HAVE, hold, exercise and enjoy the said office of Chairman of the Alberta-British Columbia
Boundary Commission, unto you the said ROBERT THISTLETHWAITE with all and every
the powers, rights, authority, privileges, profits, emoluments and advantages unto the said office
of right and by Law appertaining during Our pleasure.

IN TESTIMONY WHEREOF We have caused these Our Letters to be made Patent and the Great
Seal of Canada to be hereunto affixed.

WITNESS Our Right Trusty and Well-beloved Counsellor, Vincent Massey, Member of
Our Order of the Companions of Honour, Governor General and Commander-in-
Chief of Canada.

AT OUR GOVERNMENT HOUSE, in Our City of Ottawa, this Twenty-fourth day of September
in the year of Our Lord One thousand nine hundred and fifty-three and in the Second year of
Our Reign.

By Command,

"C. STEIN"

Under Secretary of State

Because of the wide dissimilarities in the character of the northerly and southerly portions of the boundary and in the conditions under which the new field work would have to be done, the constitution of the present Commission and the organization of its field operations were necessarily different from those of the earlier Commission.

The previously surveyed portion of the boundary ran, for the most part, through a mountainous region where precise ground surveys were feasible only across the main passes, the intervening gaps being filled in for mapping purposes by means of photo-topographical operations. Access to the general locale of the boundary was limited by climatic conditions to about 14 weeks each summer. Within this period, however, a considerable degree of flexibility in the program was possible. It was not essential to survey each of the passes in consecutive order, and the season's operations in a given series of passes could be fairly readily adapted to suit such local conditions of weather and access as might prevail.

Since the boundary was legally defined as the height of land along the Rocky Mountains, it was essential to have representatives of each province in the field, with authority to make mutually agreeable decisions as to the location of the boundary at various points where its physical position was not obvious. Demarcation of the boundary and the mapping of the adjacent territory during the short season made it necessary to have two field parties, one to do the survey and monumenting of the boundary across the passes while the other carried out photo-topographical work and monumenting on the adjacent peaks. For these reasons the Commission was constituted to consist of two provincial surveyors who would each be in direct charge of a field party and who would jointly determine questions of boundary location, with a third surveyor, appointed by the Dominion Government to inspect the field work from time to time and if necessary to act as umpire. It was also agreed that the operations of the Commission would be conducted according to instructions issued by the Surveyor General of Canada.

The northerly portion of the line is characterized by its straightness, its remoteness from the larger centres of settlement and the comparatively level terrain through which it runs. There is no possibility of dispute as to its position, since The Imperial Act defines it as a line coinciding with the 120th meridian of west longitude. The task of establishing the meridian on the ground was relatively straightforward and could best be done by a single survey party. However, the Commission felt that the chief of the field party should be qualified as a land surveyor under the legislation of both of the provinces and preferably of Canada as well, and that the remoteness of this portion of the boundary called for a man with extensive experience on northern surveys. These stipulations made the field of choice narrow, but the three surveyors employed in that capacity met the requirements to the satisfaction of the Commission.

CHAPTER II

FIELD OPERATIONS

SUMMER OF 1950

The Commission held a preliminary meeting in Ottawa on January 31, 1950 and agreed tentatively on the arrangements to be made for field operations during the 1950 summer season, subject to completion of the necessary formalities in connection with the appointment of Commission members.

At that meeting, the Commission appointed R. Thistlethwaite, D.L.S., A.L.S., B.C.L.S., then of Ganges, B.C., as surveyor in charge of field operations. It also agreed upon the rates of salary and wages to be paid to members of the survey party and the types of monuments to be used in demarcation of the line. It was decided that the accounts for expenses incurred in the work should be checked, audited and paid by the British Columbia Department of Finance, where a trust account, consisting initially of contributions of \$5,000.00 each from the three governments and maintained by further contributions as necessary, would be set up.

The Commission also laid down the required standards of accuracy of the survey measurements and the method of preparing the returns of the survey. Proposed arrangements for the provision of survey instruments and equipment were also agreed to. Mr. Thistlethwaite was asked to make an early estimate of the probable cost of the season's operations and to investigate the means of transport and routes of access to the scene of the work. On March 9, 1950, formal instructions regarding the conduct of the survey were issued to Mr. Thistlethwaite.

A description of Mr. Thistlethwaite's field work follows, based on his report of August, 1951.

Organization

Organization was commenced on February 13, 1950, when Mr. Thistlethwaite was interviewed by Mr. N. C. Stewart, Commissioner for British Columbia, and instructed to begin preparations for a season of prolongation of the boundary.

From the outset it was apparent that the most important single factor in the progress of the work would be the matter of transport. The method of transport and supply usually controls the size and makeup of the working party

to a large extent. In view of the plan to utilize pack horses for the necessary movement of supplies and equipment, the following party organization was decided upon:

The surveyor.

The transitman, a qualified surveyor, charged with the responsibility for all alignment operations and for secondary supervisory duties.

The leveller, with one rodman, responsible for the execution of the necessary differential levelling operations.

Rear chainman, with two helpers, responsible for carrying out the necessary horizontal measurements.

Picketman, assisted by 5 axemen, responsible for alignment operations at the direction of the transitman and for clearing and cutting out the surveyed line.

Moulder, responsible for the construction of the boundary monuments, under close supervision.

Cook and helper.

Head packer and three packers, responsible for the care and management of the pack horses and their necessary equipment, as required for general transport.

As is obvious, the nominal duties of the members of an isolated survey party cannot be rigidly adhered to. It became the general rule during the present survey that the efforts of every member of the party, save perhaps the cooks, were directed part time to the clearing of the line in order to stabilize the general progress of the work which was, for the most part, dependent directly upon the rate at which the survey line could be cut through the woods. A larger cutting force would probably have been more efficient but its size was dictated in part by custom and in part by the size and weight of the outfit of equipment necessary to maintain the party in the field.

May 17 to May 31 was a period of intensive organization. The party was assembled under canvas at the ford on the Beaton River, 5 or 6 miles from Rose Prairie, or about 32 miles from Fort St. John. It consisted of the party chief, H. B. Cotton, B.C.L.S. as assistant and transitman, a leveller, rear chainman, picketman, four packers, a cook, and nine labourers.

An Indian of the nearby district was intermittently employed on contract and day basis at a later date. An extra labourer was added to the party on July 8.

Thirty head of horses, of which five were saddle horses, were rented from K. F. McCusker, of Fort St. John, together with the necessary harness and other equipment pertaining to them.

The above-mentioned ford is the extremity of vehicular travel and the beginning of the old Donis Trail which traverses the country northerly. It was planned to follow this trail northerly to about the latitude of the northern extremity of the then-surveyed boundary and then to strike easterly to the boundary. Some time was lost during this period owing to non-arrival of certain technical equipment loaned by the Department of Mines and Technical Surveys to the Commission.

Transport Route

The Donis Trail was followed northerly to a point called Lake Post, about 13 miles west of the boundary on one of a string of three lakes draining into the Chinchaga River. Here the route heads northeasterly on a fairly well-defined trail to the Chinchaga River, a few miles west of the boundary. After crossing the Chinchaga, the route turns and heads northwesterly and northerly for about ten miles. It then turns east and southeast for some 5 miles to the boundary at Monument 97-5.

The party arrived at this point in the afternoon of June 9, after having rested and allowed the horses to graze for one day en route. There was no hunting for the end of the line and the route of entry was not as indirect as might have been expected. It was necessary to swamp trail only in some parts, particularly in burned areas. Forest fires were active even at this early date and smoke haze was in evidence.

Survey Operations

The days June 10 to June 13 were spent in retracing the sections of the boundary lying between Monuments 97-3 and 97-5, at which latter point work terminated in 1923. This period of retracement served as an ideal training and practice run for the alignment, chaining and levelling parties. At this time, contact was made with a seismic exploration party engaged in exploring the area east of the boundary for Imperial Oil Limited.

From June 13, the work of running new line continued without major interruption until September 19 when it was produced across the south crossing of Hay River and the terminal Monument 108-3 was set.

Line Production

As is customary, the boundary was projected across country as a series of successive extensions of the existing line. These are relatively short, ranging up to one-half or one mile in length. The forward point of each extension is normally determined by repetition of the well-known process of double-centering.

Azimuth Observations

In accordance with the instructions, the direction of the line was controlled by periodic astronomic observation for azimuth. It was provided that the boundary should be kept true north, within a tolerance of 10 seconds of arc. The azimuth of the line was to be determined at intervals not exceeding six miles by a program of observation consisting of a minimum set of three observations on the Pole Star. It was provided that the individual observations should be of such precision that a set of three would show a maximum range of variation in the results of 5 seconds of arc.

This standard of precision of alignment was maintained throughout the season's work. Observations were taken more frequently than required by the instructions. The average distance between control observations was about 2.3

miles and the maximum 5.7 miles. Some difficulty, apparently due to refraction effects and unstable ground for instrument stations, was experienced in maintaining the required precision of alignment and portions of the line had to be run a second time. Extra observations were required in cases owing to the difficulty of prolonging the straight line over slightly convex hill tops—cases where normal methods of prolongation of straight line became of doubtful accuracy due to the shortness of the sights involved and to the severe refraction effects encountered.

A Wild T2, or Universal, theodolite was used for alignment and astronomic work. This instrument, fitted with a five-second-per-division stride level, seemed to be suitable for the work at hand. No difficulty attributable to the characteristics of the instrument was experienced in making azimuth observations of the required mutual agreement.

Measurement of Distances

The measurement of the distances between the respective monuments erected to mark the boundary was carried out by means of the transit and tripod method described for previous work on the boundary, with modifications.



Chaining operation showing transit, intermediate support, and tripod



Steel skewer in position on the tripod

The instructions for this season's work allowed a tolerance of 0.6 links per mile measured, between measures of each course made respectively with a 400-link tape and a 300-foot tape. This tolerance was maintained throughout the season's work.

As a means of isolating possible errors of measurement, the chainage was carried forward in bays. At the transit positions terminating such bays, ground points were plumbed down from the transit centre. These ground points, or hubs, served a dual purpose. First, upon final reduction of a day's chainage notes, should a lack of agreement exceeding the tolerance be found between the measures by link tape and by foot tape within a certain bay, the measure of that particular bay could be repeated without incurring the necessity of remeasuring the whole distance between monuments; second, the ground points terminating the chainage bays served as intermediate points of known position at which ground levels could be determined by the levelling party.

During the season, 66.9 miles of accepted measure were done by this method, comprising 65.0 miles of new line and 1.9 miles of retracement of the 1923 survey. No difficulty was found in maintaining the specified tolerance of 0.6 links per mile although a substantial number of repeat measures were required.

The tapes used were previously standardized at the National Research Council and during the season all measures made were corrected to conform to the standardization.

The exacting nature of chaining operations is generally known. It is, in fact, the most demanding phase of the present work and it may be said that only by the exercise of a high order of ingenuity, care, systematic procedure and industry can worthwhile results be obtained. The work of the persons charged with this task during the past season was very satisfactory.

The three-man chaining party was able to chain at the rate of one and one-half to two miles of checked line per normal day, under fair conditions.

Levelling

A continuous line of differential levels was carried over the whole of the line run during the season. The procedure followed was that prescribed for baseline and initial meridian surveys under the Dominion Lands Surveys Act, subject to minor modifications. Owing to the fact that the levelling party very often worked in advance of the chaining and mounding operations, the optimum spacing and location of permanent bench marks was a matter of some difficulty. Although it was felt that a bench mark should be established at or near each monument, it was found that the monuments often were not spaced at intervals entirely suited to proper length of levelling circuits. Extensive use of temporary bench marks was therefore made, in order to create circuits of suitable length. Furthermore, owing again to the fact that the levelling party often worked ahead of the chaining party, intermediate ground points and monuments sometimes had not been established at the time of the initial forward run of the levelling party.

It was the custom, therefore, to determine the elevations of such points on either the forward or check run, whichever was the most convenient.

Also, although it is mandatory in D.L.S. work to determine ground levels at even 20-chain intervals, as a minimum, it was found impractical for the chaining party to establish such points on the ground by the method of chaining used. Ground levels were therefore taken at the terminal points of chaining bays, generally lying about 16 to 20 chains apart. The net difference is slight and it is found that the number of ground levels determined is adequate to define the ground surface.

The levelling operations were well carried out by the leveller and were at no time a limiting factor in the progress of the party as a whole.

During the season 86 permanent bench marks were established at an average interval of 60 chains. This involved the use of 118 closed level circuits, averaging about 44 chains in length.

Line Cutting

The terrain traversed by the boundary from Township 97 to Township 108 is wooded throughout.

The boundary line was cut out, in accordance with instructions, so as to clear a width of six feet at the sky line. This, of course, necessitated a much wider clearing at the ground level; in fact, it was often necessary to cut trees standing 15 or 20 feet from the centre line.

Trees were blazed on each side of the cutting in accordance with general practice. The British Columbia quartering blaze was used on the west side of the line and the standard D.L.S. blaze, consisting of three faces square to the line, on the east side.

The opening of the line was, throughout the season, the limiting factor in the progress of the survey party. The normal axe crew consisted at first of five men. One man was added later without appreciable betterment of progress. Every effort was directed toward line-cutting at all times. The chaining and levelling parties normally devoted part of each day to cutting line. It was found that, except in rare areas of easy cutting, these parties could devote about half their time to cutting and the other half to chaining and levelling.

The woods encountered ranged from heavy spruce, jack pine and poplar down through scrub spruce, alder and willow. Growths of large spruce, ranging up to 30-inch diameter, accompanied by jack pine, aspen and balm approaching similar size were found on hilltops and along watercourses and in other areas where fires have not penetrated for many years. Line-cutting was very slow in this kind of timber.

Heavy stands of aspen and balm were encountered later in the season and these too were troublesome since the heavy crowns necessitate a very wide cut-

ting of the base in order to clear the necessary sky line. Areas of smaller spruce and jack pine were in places so dense as to seriously impede the passage of a man on foot. There were many drainage areas covered with heavy growths of alder and willow which impeded the line-cutting almost as much as the stands of heavy timber. Areas of arctic willow, standing about three feet high, were very bothersome. On the whole, the difficulty of the task of opening the line is truly reflected in the season's progress.

Magnetic Declination

The magnetic bearing of the boundary was observed directly at 12 different points by means of Wild Compass No. 6552. This provides a corresponding number of values for the magnetic declination.

Connections with Previous Surveys

Since the part of the boundary which was run this season traverses unsurveyed territory, no previous surveys were encountered.



View south toward Mon. 97-4 on the 1923 line



Cut line, Township 97



Aspen, Township 98



Spruce, Township 106



Deciduous trees, Township 105

Following instructions, the starting point for this season's survey, that is, Monument 97-5 established by Mr. Cautley in 1923, was verified beyond doubt by retracing the sections of the boundary lying between Monuments 97-3, 97-4 and 97-5.

To begin with, the old cutting in this vicinity was quite clear and unmistakable. Although the surface was overgrown with willow and alder, the larger timber had encroached but little and the skyline was quite open.

Monuments 97-3, 97-4 and 97-5 were found in good condition, with posts intact. The mounds and trenches were grown over with grass and small brush. However, except for a general rounding-off of their angularities, they were in good condition.

Bench marks 72 and 73 were found. Number 72, however, was destroyed—the tree having died and fallen. Levels were run between Monuments 97-3, 97-4 and 97-5, and 97-5 was connected to bench mark 73.

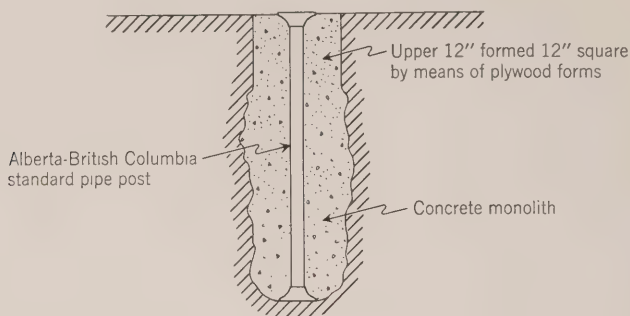
Boundary Monuments

Sixty-four monuments were placed on the boundary during the season, spaced at an average distance of 81 chains. These monuments were all of the secondary type described on pages 94 to 97, Chapter II of Part III-B of the Boundary Commission's Report, and they conform to the specifications there set out. There is a minor difference in the engraving on the cap of the posts used in 1950, in that a crown appears at the top of the cap and the digits 195— at the bottom, as is shown in the diagram below, as well as a statement of protective penalty.



One or more bearing trees were made at each monument where suitable trees existed. These further perpetuate the monuments.

In order to increase the permanency of the monumenting, certain of the posts, at intervals of about 6 miles, were imbedded in concrete. The following diagram shows the general form of this added protection.



Gravel was not available at certain of the sites chosen for concreting. In these cases the standard iron post was imbedded in a mass of neat, wetted Portland cement (1 bag) and the squared top was omitted. The upper 10 inches, approximately, of the hole dug to receive the post and cement mass was back-filled with dirt. This alternative method of enhancing the permanency of the monument should be quite effective despite the lack of gravel.

Each of the posts set was stamped with the corresponding number, according to the system of numbering used on the 120th meridian previously. That is to say, each post was marked (by means of steel dies) with the number of the township in which it lies, followed by its number in order from the south boundary of the township. That is, the first, second and third monuments in township 98 were stamped 98-1, 98-2 and 98-3, and so on, throughout the length of the boundary.

Photography

Photography was used extensively throughout the operations of the survey party. Vertical air photographs taken by the Royal Canadian Air Force as a part of the normal mapping program covering Canada were used to good advantage. A strip of mapping photographs which covers the projected boundary was selected and carried in the field. Inspection of these photographs before the commencement of field operations yielded invaluable information about the terrain and conditions which were later to be encountered and assisted materially in the planning of the project. The actual field operations benefitted by their use in planning and controlling the day-to-day work. Selection of the most suitable camp-sites became a relatively simple matter and the optimum movements of the camp could be intelligently planned without the need of laborious reconnaissance in the field. Furthermore, the strip of country traversed by the boundary can be fairly accurately mapped in some detail by the use of these photographs and a process of analogy based upon the conditions and



Typical monuments under construction

circumstances encountered upon the survey line itself. In this way the services and efforts of the exploration and mapping group which normally used to be attached to similar survey parties are dispensed with.

Fairly extensive use was made of ground photography for recording in pictorial form some detail of the terrain and forest growth encountered, together with views of the monuments constructed and illustrations of the methods or processes used. Selections from these photographs form part of this report.

Transportation

The normal day-to-day transportation of the equipment and supplies for the survey party was carried out by means of pack horses. This had been the original plan but the outcome was somewhat doubtful on account of the lack of first-hand information concerning the existence of suitable grazing areas for horses and also the possibility of encountering impassable swamp or muskeg areas. Fortunately, as it turned out, the horses were able to maintain themselves by grazing throughout the season. Forage became increasingly scarce, however, as the work progressed northerly. Another fortunate circumstance was the dryness of the season. Certainly some of the areas traversed by the pack animals this season would be impassable in wetter years. As it was, some difficulty was experienced with wet areas and some considerable detours were made necessary. The matter of transport was an important controlling factor in the operations of the party.

The fullest practicable use was made of mechanical transportation facilities. At the outset the whole party was moved to the extremity of vehicular traffic about 32 miles from Fort St. John, before commencing the long trip on foot to the end of the previously surveyed boundary. At the termination of the summer season, the whole party, exclusive of horses and packers, was moved by charter airplane from Ekwan Lake to Charlie Lake at Fort St. John.

Camping Equipment

Camp and other equipment was necessarily restricted to minimum weight in view of the method of transport. Housing consisted of nine small sailcloth sleeping tents, a larger office tent of the same material and a canvas cook tent. Cooking was done on a pair of sheet metal stoves of special design for pack horse transport. Personal equipment was restricted to bedrolls and wearing apparel. The remainder of the load transported by the thirty horses consisted of food, Portland cement for monuments, a supply of survey posts and the necessary tools and technical equipment for the survey.

A portable forestry-type radio transceiver was also carried. This is a $2\frac{1}{2}$ -watt, battery-powered set especially designed for such purposes. It gave quite good results in that fairly regular daily communication was maintained with the British Columbia Forest Service at Fort St. John over a maximum distance of 150 miles. The use of some such means of communication is almost essential in

modern field operations especially under such isolated conditions. Party morale is much higher when it is known that help may be obtained in case of severe illness or accident. Certainly the provision of this kind of communication enables greater latitude in the way of selection of methods of transport and therefore in most cases, greater efficiency.

Summary of Progress

Progress by months, as recorded by the chaining party, was as follows:

		Down Time days
June (14-30).....	11.5 miles	2
July.....	22.0	5
August.....	17.6	8
September (1-19).....	13.9	3
Retracement.....	1.9	
	66.9 miles	18 days

The down time quoted above refers to the cutting crew and does not include short or part-day delays due to rain, snow (which occurred August 14), etc. During the period July 31 to August 8 a malady seized the crew and caused a high loss of time, particularly among members of the cutting force. The sickness is believed due to the use of stagnant water in what we have called Poison Creek (re-named Foulwater Creek by the Canadian Board on Geographical Names). It caused general malaise coupled with soreness and stiffness throughout the body, swelling behind the ears and in some cases vomiting. Diarrhoea did not seem to be a general symptom. The sickness disappeared when camp was moved away from this stream.

Mr. Thistlethwaite summarized the work of the summer season of 1950 as follows:

".....it is appropriate to remark that the efforts of the party were generally satisfactory except in the matter of line-cutting. Although the men were carefully picked and some were excellent axemen, the morale was increasingly poor as the season progressed. All supervisory efforts to stimulate activity and progress were of little effect. This was in part due to the isolation of the party which prevented effective pressure, and in part, to the lack of strength-sustaining food, particularly fresh meat. The latter effect was felt by all members of the party. The overall progress of the party could have been better, with proper morale, in spite of the heavy cutting encountered in parts".

WINTER OF 1951

The nature of the terrain north of the point where Mr. Thistlethwaite's 1950 summer operations were terminated indicated that further progress with the survey during a summer season would be difficult and uneconomical, if not impossible. The territory which lay ahead consisted of a vast stretch of swampy country through which the line would have to be run for 20 to 25 miles before

higher and firmer ground could be reached. It was advisable therefore, to consider the practicability of carrying the survey forward during the winter when frost conditions would render the ground passable.

Because of some uncertainty regarding the availability of funds and because of the absence of the chairman of the Commission at a survey conference in New Zealand during the fall of 1950, it was not possible for the Commission to consider the feasibility of winter work until November 27, when a meeting of the Commission was held at Victoria, B.C. It was there decided to have Mr. Thistlethwaite investigate the possibilities of a winter survey beginning early in January, 1951.

It was the Commission's opinion that a winter survey could best be carried out by using tractors for transportation to the scene of operations and for clearing line. The Commission did not have a great deal of information with regard to previous winter surveys on which tractor transportation had been used, but the available information indicated that this method of operation should prove satisfactory. Mr. Thistlethwaite was therefore instructed to proceed on the assumption that tractor transportation would be used, and to obtain estimates of the probable cost.

As it turned out, the survey operations undertaken during the early months of 1951 achieved far less than the Commission had hoped for. The line was extended only 25 miles owing for the most part to transportation difficulties.

After making enquiries, Mr. Thistlethwaite reported to the Commission that it appeared to be feasible to carry out a winter survey beginning about January 15 and covering approximately 75 days of field operation using tractor transportation, the probable cost being approximately \$37,500. The Commission then authorized him to negotiate a contract with a suitable tractor operator and to proceed with the survey work as soon as possible.

The execution of the subsequent field operations is described as follows, based on Mr. Thistlethwaite's report to the Commission:

Upon receipt of the Commission's instructions, as of November 28, 1950 Mr. Thistlethwaite immediately took steps to investigate the possibility of continuing the boundary survey during the winter season. It became apparent that suitable tractor equipment and services could be obtained in the Edmonton vicinity and he proceeded to obtain definite proposals from two companies. By the evening of January 10, a provisional agreement had been reached with one of these companies for supply of two tractors (Caterpillar D8 and International TD4, equipped with bulldozer blades and winches), 6 logging sleighs, 3 cabooses and a "jeep"-type vehicle. Attention had also been given to many of the other details of organization.

The period January 11 to 16 was spent in Victoria preparing technical data for the new survey, making final arrangements with technical personnel, and attending to other administrative matters. The company had agreed to have the

mechanical equipment at Upper Hay River (re-named Meander River by the Canadian Board on Geographical Names, May 6, 1954), on the Mackenzie Highway, ready to start the journey to the boundary by January 22. It was difficult to arrange to have all the necessary personnel and widely scattered equipment assembled at Upper Hay River by that time. However, by January 16 everything appeared to be well in hand and Mr. Thistlethwaite returned to Edmonton on the 17th.

Although no new formal instructions had been issued for the continuance of the boundary survey, it was tacitly agreed that the methods of survey should be the same, except for the modifications required by the use of bulldozers rather than hand labour for line-clearing.

Organization of Party

The chief difference in party structure would obviously be the use of fewer axemen. In addition, frozen ground conditions would require a larger force for monument construction. Operation and maintenance of mechanical equipment would require special personnel.

The number of men who could be employed was restricted by the living space provided by the mobile camp. It transpired during the course of the survey that two or three extra men could probably have been employed profitably in various intermittent capacities. However, the sleeping cabooses provided limited space for only 16 men.

The tractor foreman and his four men were employees of the tractor company, seconded to the survey party under the agreement with the Boundary Commission.

The final party roster, on leaving Hay Lake, consisted of the party chief, H. A. Wicks as assistant and transitman, a leveller, a chainman, two labourer-chainmen, a picketman, a rodman, three mounders, a cook, and one labourer, as well as the five employees of the tractor company.

These men remained with the party throughout the working season. Party disbandment after arrival at Upper Hay River was efficient in spite of the spring road ban which prohibited operation of heavy vehicles in the area. Party personnel and technical equipment were moved by charter truck to Peace River, Alta., and caught the next train for Edmonton, each member then proceeding directly to his point of engagement. Most of them reached their respective bases and were released as of April 4, 5, and 6.

Transport to the Boundary

The route of entry to the winter work was by way of the Mackenzie Highway northward from Grimshaw or Peace River, Alberta to Upper Hay River. From the latter point a fairly well-used trail was known to exist leading to Hay Lake Post, roughly half way between the highway and the lake. It was planned to break trail by means of the bulldozers westward from this point to the site of

the food cache which had been established during the previous summer on the Hay River at the boundary crossing. Thence, the outfit was to make its own trail southerly to the end of the previous season's work at the south crossing of the Hay River.

The company's equipment was loaded and consigned for shipment by rail, to leave Edmonton on the evening of January 20 for Grimshaw. The shipment was rejected, however, due to faulty loading and finally did not arrive at Grimshaw until January 24. On unloading at Grimshaw, one of the tractors was badly damaged and repairs were not completed until January 29. In the meantime, other portions of the equipment and personnel had gone forward toward Upper River as suitable trucks became available.

Departure from Upper Hay River was not possible until February 2; even then certain critical equipment was not on hand and at least half of the required fuel supply could not be loaded.



Tractor train with kitchen and sleeping cabooses

Mr. Thistlethwaite agreed to proceed, upon the assurance of the company's superintendent that he would dispatch the missing equipment and fuel by truck to follow over the trail until it overtook the party. The party therefore set out westward during the morning of February 2, one tractor drawing three fuel and supply sleighs and the other the three cabooses.

The first 22 miles of trail were comparatively easy going as they had been plowed and bladed by tractors engaged in oil exploration. However, considerable trouble and delay was caused by breakages of the draft connections in the sleigh trains. On leaving the plowed trail it was found that the tractors were not able to draw the sleigh trains and to plow trail at the same time. The practice then was established of alternately plowing trail ahead for a large part of each day and then moving the camp forward on the following day to the end of the plowed trail. The party reached Hay Lake on February 6 after covering 61 trail miles in five days.

By this time it became apparent that it would be useless to proceed further until the missing equipment and fuel had been received and incorporated into the loads. The party, therefore, spent the following $4\frac{1}{2}$ days at Hay Lake in overhauling and re-arranging the draft gear of the sleigh trains, re-arranging loads, preparing a crossing at Omega Creek, plowing trail forward and to the rear, and setting up radio equipment at the Hudson's Bay Post. Modification of the draft gear of the fuel sleighs was held up as the welding equipment was inoperative. The crossing at Omega Creek required fairly extensive earth movement by the bulldozers and some dynamiting.

The journey westward was resumed in the afternoon of February 11, each tractor drawing three sleighs upon which were carried the entire load of fuel and equipment and the cabooses.

On February 13, the pack trail led the party into the wooded country bordering the Hay River and the tractors were no longer able to make trail and move the loads simultaneously. The procedure then reverted to a process of alternately making trail and moving loads forward.

The advance continued westward in this manner through fairly heavily wooded country until the morning of February 20 when the food cache was reached. This cache was established during the summer of 1950 on the north bank of the Hay River, near the boundary crossing, 56 trail miles from the Post. It had provisions for 1,200 man-days, which had been transported from Hay Lake Post by wagon and pack horse.

The journey westward from Zama Lake was marked by numerous breakages of the draft linkage between the sleighs. Most of these were minor matters causing only short delays. In one case, however, a whole day was lost when breakage of a linkage caused extensive damage to one of the fuel sleighs. The entire load platform had to be rebuilt with native timber and major repairs were required to one sleigh-bob and the draft linkage.

On reaching the food cache, the advance was directed southerly toward the termination of the previous summer's work, some 25 miles due south. A suitable crossing of the Hay River was found immediately. Approaches were built in a matter of a few hours by the bulldozers and trail-breaking continued southward.



During a breakdown on the entry trail



Food cache as found in February

The journey southward through the wooded terrain between the north and south bends of the Hay River was slow, but for the most part, uneventful. By the use of aerial photographs the most serious obstacles were by-passed. One tractor which was mired in the bed of a small stream during trail-breaking operations was extricated within a couple of hours by means of the companion tractor and was back in operation the following day. It is doubtful if the machine could have been retrieved without the help of the second tractor. Such incidents emphasize the advisability of operating bulldozers in pairs for this kind of work. The provision of winches is also an essential safeguard.

The train arrived at Monument 108-3, the terminal point of the summer work, in the late afternoon of February 25, having moved southward 28 trail miles in six days. The move from Upper Hay River, on the Mackenzie Highway, a distance of 145 trail miles, had taken 24 days.

This contrasts sharply with the withdrawal journey from the Hay River cache to Upper Hay River, a distance of 117 miles, which was made in five days, including a one-half day stop at Hay Lake Post. The difference is due mainly to the load carried and the time spent in trail-breaking operations.

Transport During Season

After arrival of the tractor train at Monument 108-3, on February 25, transport operations consisted almost entirely of successive movements of the mobile camp and fuel trains forward over the cut line. These movements occurred each morning, for the most part, over distances of a mile or so. As a general rule, each tractor began moving its respective train forward at 7:30 a.m. and the moves were generally completed during the period 8:00 to 8:30 a.m. The survey personnel were usually free to begin their daily work at 7:30 or shortly thereafter. At least one tractor was normally free to begin work on the line-clearing shortly after 8:00 a.m. while the other was detained for a short time in spotting the camp and equipment in its final position. It was often found, however, that one or the other tractor required some service or repair. This would be done after completion of the move, if possible.

Provision of a jeep vehicle for line work was perhaps an innovation. It had been thought that inasmuch as the cut line would have to be cleaned out fairly well to allow movement of the sleigh trains, the jeep could be used to good advantage in moving survey personnel and tools along the line during the course of the work. Certainly it did save much valuable time on occasions when long realignments became necessary and also when tractor breakdowns necessitated trips to camp for parts or tools. Some 250 miles were travelled by the jeep in connection with the survey work proper. Concerning its disadvantages, Mr. Thistlethwaite reported as follows:

"In certain places where the bulldozers were not able to plow the trail out clean due to the danger of breaking through the muskeg crust, the jeep was not able to move under its own power and it here became a handicap rather than

an asset. It is not very clear whether or not the provision of this vehicle justified the expense and trouble of moving it in to the line. It certainly could not be used for emergency transportation over the entry trails."

The final movement of the camp on survey activity diverged somewhat from the actual cut-line. Rather than find and prepare a new crossing of the Hay River, in the vicinity of the line, trail was opened easterly to connect with the entry trail and the camp was moved over the original crossing to the site of the cache. The last day or two of survey work was carried out from this camp, which lay about three-quarters of a mile east of the boundary. This enabled efficient loading of the remainder of the cache and preparation for the return trip to Upper Hay River, as well as the caching of certain articles of hardware, posts, cement, etc., which would be needed for a succeeding survey.

Termination of the work at this time was enforced by two factors, equally decisive. Advice received by radio from meteorological sources had demanded arrival of the tractor train at the highway not later than April 1 because of spring break-up. Also, the fuel supply for the tractors was sufficient only for the return journey.

Line Production

The normal, basic methods of alignment described for the summer operation were continued during the winter season. Instrumental equipment differed. The Wild T2 theodolite which had been used before was sent to Ontario Hughes-Owens Ltd. at Vancouver for winterizing, along with other instrumental equipment. It was found, however, before the commencement of the survey, that the vertical motion of the theodolite was so stiff under low-temperature conditions that it could not be used. A second, identical, instrument was obtained from Ottawa after having similarly been winterized and tested under low temperature conditions by the National Research Council. This too, was found to be too stiff in the vertical movement to allow its use for line-production and astronomic work under low-temperature conditions. Fortunately a winterized 6-inch micrometer transit of the type known in Dominion Land Surveys circles as a base-line transit had been provided as a spare. This was put into service for the alignment and astronomic operations.

In reference to this transit, we quote Mr. Thistlethwaite:

"Considerable difficulty was experienced in the use of this instrument. The personnel concerned were not practised in its use, being accustomed to using more modern instruments such as the Wild T2. Although the operation of producing a straight line should not have, and apparently did not, present any particular difficulty due to the use of a different instrument, it was found as the season progressed that serious errors of mis-alignment were more than normally frequent. For this reason, a large proportion of the boundary surveyed during the winter season was run twice—a portion of it three times. The reason for the difficulty has not been determined although every effort was made in the field

to eliminate incorrect procedures. It is believed that such procedures were corrected. The errors persisted, nonetheless. This leads to a suspicion that the instrument was in some way defective, although ordinary examination revealed no untoward circumstance."



The 6-inch base-line transit with the stride level in position

The alignment operations were at times hampered by bad visibility due to snow. At such times, and generally, it was expedient to use a second transit, working ahead of the final alignment, to carry an approximate line for the bulldozers working on the line-clearing.

Azimuth Observations

The matter of astronomic observations was equally troublesome to Mr. Thistlethwaite. To quote:

"In the beginning it was found that natural lighting was unsatisfactory for reading the horizontal circle, and electric lighting was resorted to. The winterization of the micrometers was also unsatisfactory and they had to be dis-assembled in the field to correct the condition.

"In general, great difficulty was experienced in securing consistent agreement between the alignment and the astronomic controls. This led to excessive re-alignment and undue repetition of observations which in turn limited the

over-all progress of the survey to an appreciable extent. Astronomic work under low-temperature conditions was found to be particularly trying and there is no doubt that this circumstance contributed to the general difficulty. Eleven acceptable observations were made during the season in controlling the 25 miles of boundary which were surveyed."



Line clearing in heavy windfall

One of the final azimuth observations of the season was made in warmer weather, allowing the use of the Wild instrument. After having used the base-line instrument throughout the season, the facility with which the observation program was carried out with the Wild was notable. The results obtained, in this case which permits comparison, were almost identical.

Line Clearing

The line-clearing function for the survey was done almost entirely by the bulldozers. The area traversed during the winter season is wooded in some degree throughout. The growth, though generally not large, is in parts extremely dense. The line was cleared out to a minimum six-foot width at the sky line as on previous work. Inasmuch as the mobile camp had to be transported along the cut line to avoid opening another special trail for that purpose, all stumps and trees had to be removed at the ground level to allow passage of the sleighs. Some blading had to be done also to smooth the way for them. At

points along the line where transit stations or monuments were established the tractors had to clear bypasses to allow passage of the mobile equipment without disturbing the survey marks.

Generally, the clearing force consisted of the two bulldozers with their operators and the picketman. The latter, by placing stakes on line behind the tractors as directed by the transitman, was able to control the direction and width of the clearing. The picketman was also responsible for cleaning up behind the tractors and removing occasional overhanging trees. He made suitable blaze trees and received alignment points as these were projected forward by the transitman from the rear.

The final result was an opening through the woods of the width specified for the boundary cutting and also a trail for the passage of the mobile camp equipment. Creation of this trail provided good working conditions underfoot for the chaining and levelling parties. In the dense woods, many passes were required to make the required clearing and the two tractors working together often could not clear more than one-half to three-quarters of a mile of line a day. At the other extreme, in sparsely wooded muskeg country, one tractor alone could clear several miles a day since the operation amounted to little more than plowing snow to make trail for the mobile equipment and the survey groups.

Owing to heavy snowfall the muskeg areas were but lightly frozen and it was not possible to blade the ground surface without incurring the risk of breaking the crust and allowing the heavy machines to break through and be mired. Wet muskegs would not support the tractors and extreme care was necessary in judging the character of the terrain ahead as the tractors advanced. In some cases disaster was only averted by reason of the presence of a second tractor and of the fact that both were fitted with winches. Muskeg areas, which are characteristically rough and hummocky and which could not be bladed, caused the most severe strains on the sleighs and it was in such areas that the majority of breakages occurred. Tractors were likewise severely strained and jolted in traversing this kind of terrain. Had frost conditions permitted even a little blading, the task would have been easier.

The normal daily routine for the tractors began with the movement of the supply and caboose sleigh trains forward over the cut line to the end of the previous day's work. Once there, the lead tractor proceeded to open new line while the survey groups went about their tasks. The rear tractor, having spotted the camp in a convenient bypass or having made a suitable turnout for the purpose, then proceeded to the line also. Work was then continued throughout the day and the tractors and survey groups returned to camp in the evening.

During the 29 days available for line work each tractor operated on line-clearing operations an average of 4.39 hours a day and stood by, on the average, 2.63 hours. In the 254.61 tractor hours devoted to the purpose, 24.75 miles of line were cleared; the rate of clearing thus being 10.2 operating tractor-hours per mile of line cleared. The standby time is considerably higher than it

should be, as the tractors were not able to proceed with the line clearing on various occasions during the time required for revision of the alignment caused by the difficulties mentioned previously. Tractor time used in transporting the mobile camp along the line is included in the above figures. It is estimated that actual net clearing time would be in the neighbourhood of $8\frac{3}{4}$ hours per mile of line cleared, exclusive of moving and walking time.



Sleigh train spotted in a by-pass

A notable feature of the work was the interference with survey operations caused by the presence of the tractors and sleigh trains in the cut line over which the survey was being made. Owing to the mobile nature of the camp and the system of movement adopted, the cabooses and mechanical equipment were at all times within one or two miles of the current surveying operations. Since the terrain is quite flat, a caboose or tractor on the line effectively blocked any sighting operation. There were, therefore, occasions upon which delays were caused to the surveying groups. One case in particular, involving the break-down of a sleigh train at a commanding point on the line, held up alignment operations for a half-day. Under normal circumstances, the possibility of interference was restricted to the period of the movement of camp in the morning and to the evening period during which the tractors were returning from the head of the line to the camp. Often the latter period coincided with the optimum opportunity for astronomic work.

The use of mobile housing results in a notable economy in the productive time of survey personnel. Owing to the fact that the living quarters were at all times within a mile or two of the actual surveying operations, unproductive walking time was minimized. Also, no time is spent in setting up and breaking camp or loading and unloading equipment as would be the case with a tent camp. Therefore, while the cabooses provide anything but comfortable living conditions owing to extreme restriction of space and poor regulation of temperature and ventilation, it seems that their use is definitely advantageous.

Measurements

The system of horizontal measurement which was used during the preceding summer was modified somewhat for the winter season. Some doubt had been expressed as to the degree of independence of measures achieved by the system of simultaneous chaining with foot and link tapes. Therefore, Mr. Thistlethwaite resolved to dispense with the method involving the use of transit, tripod and intermediate supports and to substitute the normal method of chaining along the ground. Chainage forward by means of a link tape was to have been verified and checked by a non-simultaneous measure with a foot tape, in the opposite direction.

This method was initiated at the beginning of the winter season. However, the chainmen felt so little confidence in the results that it was immediately decided to revert to the transit-tripod method, with the provision that each course should be measured twice. The initial measure was to be made in one direction with a link tape, employing the same equipment and precautions as had been the case on the previous summer work. This measure was then to be checked by a second measure of equal precision made in the opposite direction with a tape graduated in feet. This provision would satisfy beyond doubt the requirements of strict independence of measures.

It was found as the season progressed that the rate of chaining by the new method was as rapid as that during the summer, if not more so. The underlying reason seems to be that unproductive walking was minimized by the nearness of the living quarters. Under the conditions prevailing, up to two miles of verified measure could be achieved in a normal working day without much difficulty. The average discrepancy between respective measures of each chainage bay, for the winter season, amounts to one part in 44,000 or 0.18 links per mile. Some repeat measures were required to achieve the specified tolerance of 0.60 links per mile. Twenty-four miles and 64 chains of accepted boundary measure were recorded during the effective survey season of 29 days. One lateral connection, 26 chains in length was made to tie in an existing traverse survey.

Monumenting

The monuments constructed to mark the boundary during the winter season were all of the standard form prescribed for the previous summer. The necessary excavation was done by means of pick and shovel by three men. They

experienced no particular difficulty in keeping up with the general progress of the survey and it is thought that a general advance of two miles per day could have been maintained without unduly taxing the efforts of the mounding crew. It was perhaps fortunate that the ground in many sites chosen for monuments was



Construction of a typical monument

quite dry before the freeze-up and therefore was not overly resistant to digging. A supply of dynamite was carried along with the general equipment for use, if necessary, to loosen the frozen ground at monument sites. However, it was never necessary to use it.

Twenty-three monuments were constructed during the course of the survey at an average spacing of 86 chains. As the supply of iron posts was not quite sufficient to allow average 80-chain spacing over the remainder of the boundary, Mr. Thistlethwaite deliberately kept the average spacing slightly higher than the specified one mile.

As no gravel was available, none of the monument posts was set in concrete as required by the instructions. As an alternative at four chosen sites, the standard post was imbedded in one bag of dry Portland cement placed around the foot and lower part of the post, on the expectation that ground moisture, after spring breakup, would set up the cement so placed and form an effective enhancement of the permanency of the monument.

Bearing trees were made wherever suitable trees existed.

Levelling

Differential levels were carried over the entire length of the boundary run during the winter season. This work presented no unusual difficulty and the methods were similar to those followed during the summer. The levelling party was able to keep pace with the general progress of the survey quite easily and could have achieved a great deal more, had the survey been extended. Forty-six closed and checked circuits were run, involving the creation of 44 new bench marks. In some cases where suitable live trees did not exist the standard posts forming monuments were used as bench marks.

Magnetic Observations

On attempting to carry out the prescribed observations for the determination of the magnetic declination it was found that the Wild compass provided for that purpose had not been properly winterized and would not function at low temperatures. For this reason only one observation was obtained, on a mild day at the end of the season.

Photography

Considerable use was again made of aerial photography in planning the day-to-day operations of the party and also for reconnaissance purposes. The Air Division of the British Columbia Surveys and Mapping Branch had made a photographic flight exactly along the projected boundary during the summer of 1950.

The air photographs were very valuable in planning the route of travel of the tractor train from Hay Lake to the termination of the summer survey. It was necessary to make 28 miles of tractor trail extending southerly across country from Hay River at about longitude 120° to the point of commencement of the survey. The use of the photographs enabled easy choice of the optimum route.

Ground photography was used principally to record views of the monuments. Atmospheric conditions were not always suitable for photography and the quality of some of the photographs was poor for this reason. A number of views were recorded for illustrative purposes.

Ties to Existing Surveys

No cadastral or legal surveys exist along the route of the winter survey. A lateral connection, 26 chains in length, was made to Topographic Station 1452. This station is the terminal point of a traverse along the northern bend of the Hay River, run by Topographical Survey Division, Department of Mines and Technical Surveys. This connection was made at the request of that Division and the technical details thereof were transmitted in Mr. Thistlethwaite's letter of July 9, 1951.

Camping Equipment

There are some disadvantages as well as advantages in the use of mobile sleeping and dining cabooses for the housing of the party personnel. The width

must be restricted to about eight feet and a length in the neighbourhood of 20 feet is about all that can be conveniently manoeuvred in a sleigh train. Therefore, a logical arrangement of bed space is four double-deck beds, one in each quarter. In cold weather the floors and lower beds are very cold, while the men in the upper beds cannot sleep for the heat. When eight men and their personal equipment are crowded into a caboose of this size activity is restricted to lying on the bed. Office work is almost impossible. The comfort of such cabooses would be greatly increased by the provision of insulation for the floor.

Proper heating is also difficult. The sleeping cabooses were heated by oil-burning space-heaters, each of which consumed 5 to 7 gallons of stove oil a day. These heaters were taxed to the utmost and were insufficient in the coldest weather.

It would be very difficult in sparsely wooded or muskeg terrain to secure enough fuel for wood-burning heaters, especially under conditions requiring extended movements of the tractor trains. As it was, keeping the cooking range supplied kept one man fairly busy and at times became almost impossible.

Communication

The radio transceiver used during the summer again served for communication purposes. In view of the increasing distance from Fort St. John, a companion set was installed at the Hudson's Bay Post at Hay Lake. A. K. Black, the Post manager, was most co-operative and maintained a daily schedule with the field party. He was thus able to relay party messages via his company's communication system to the R.C.C.S. station at Fort Resolution, N.W.T. Fairly consistent communication was maintained throughout the season and though no real emergency arose, it enabled aerial delivery of some much-needed tractor parts on one occasion.

A portable, all-wave battery receiver was also carried. It was used to receive radio time signals which facilitated the astronomic work and also to provide news of the outer world and a little entertainment.

Conclusion of Field Operations

The survey having been carried as far forward as possible, the tractor train set out on the return journey to Upper Hay River on the morning of March 27. Progress was good despite poor sleighing conditions due to lack of snow on the trail, and the train reached the Mackenzie Highway by way of the entry trail on the afternoon of March 31.

Owing to thawing conditions, a ban against heavy vehicles had been placed on the Highway. The contractors' heavy equipment was therefore stored at California Standard Oil Company's base some 10 miles south of the survey's marshalling point.

Summary of Progress

Mr. Thistlethwaite summarized the season's work as follows:

"During the 29 days available for survey operations, 24.7 miles of boundary were run. Twenty-three monuments and 44 bench marks were established. Progress during the 29 net days available for survey work was only about half of what had been expected. This was due to a combination of causes. Among these was the unexpected difficulty in maintaining the alignment. This factor could well be eliminated in future work. Another factor was the continued fouling of the radiators of the tractors by debris from the woods, which caused a shutdown for cleaning about every hour of working time. This could be avoided by appropriate screening of the radiators. Personnel morale was again poor during the winter season, particularly among the mechanical crew. Further, payment for tractor services on a rental basis, without direct incentive for high output does not seem to be the best possible arrangement, although it is customary on such work. Length of working season is also an important factor. The expense of moving a heavy outfit of machinery so far across country is not justified for a short working season. Although custom favours beginning tractor work about mid-January in order to obtain maximum ground-frost penetration, local opinion considers that conditions are as good soon after freeze-up as ever. Much depends upon the depth of snow on the ground—however, it is said that the frost does not penetrate much after the first heavy snowfall. Certainly a local appraisal, backed by actual test of frost penetration in the district, should be obtained before a tractor train takes the field."

WINTER OF 1951-52

On August 20, 1951, the Commission met at Edmonton to consider the report and returns of survey which had been prepared and submitted by Mr. Thistlethwaite, covering the field work done by his party during the previous summer and winter and to make arrangements for continuation of the survey.

The Commission approved Mr. Thistlethwaite's returns, subject to such corrections as might be found necessary upon technical examination by the staff of the Chairman's office. It was agreed that his note books of magnetic observations be transferred to the custody of the Dominion Observatory and that his proposed new names for noteworthy topographic features encountered during the course of the survey be submitted to the Canadian Board on Geographical Names for approval.

The Commission had learned with regret that Mr. Thistlethwaite's services would not again be available as he had entered the permanent employ of the Canadian Government subsequent to the conclusion of the preceding season's boundary survey work. It was therefore necessary to appoint a chief of party to succeed him and it was agreed that Mr. William N. Papove, D.L.S., A.L.S.,

B.C.L.S., of Vancouver, B.C. be approached by Mr. Stewart. It was agreed that the survey work should be continued during the winter of 1951-52 if Mr. Papove's services could be secured.

The question of transportation was then considered in some detail and in view of the unsatisfactory results which had been obtained with tractor transport during the previous winter, it was agreed that the possibilities of using horses and dog trains, perhaps supplemented by intermittent aircraft supply, be investigated fully.

On September 19, 1951, Mr. Stewart reported that Mr. Papove would be available upon completion of his current survey work on the Alaska Highway in northern British Columbia. Formal instructions similar to those issued earlier to Mr. Thistlethwaite were then sent to him. He was particularly directed to make a thorough inquiry into possible means of transport and to submit recommendations with an estimate of probable costs.

Mr. Papove had interviewed Mr. Stewart at Fort St. John on September 22 and 23, and on October 19 he arrived at Edmonton where he interviewed Mr. Holloway and obtained from him particulars of the transport facilities which appeared to be available at northern Alberta points. On October 20, he left Edmonton and visited Peace River, Hay Lake and various points along the Mackenzie Highway where further information on transport was secured and arrangements were made for engagement of local labour and for the purchase of horse feed and other supplies.

On October 27 Mr. Papove returned to Edmonton where consultations were again held with Mr. Holloway and with Mr. C. B. C. Donnelly, D. and A.L.S., who was then at Edmonton organizing a winter survey on the Alberta-Northwest Territories boundary. As a result of these discussions and in view of the conditions indicated by Mr. Papove's inquiries in northern Alberta and by Mr. Thistlethwaite's reports, the following arrangements with regard to transport and supply were decided upon:

1. For transport of camp equipment on the boundary, two teams of horses drawing bob-sleighs fitted with racks and a spare horse drawing a toboggan sled would be used. Tentative arrangements for the engagement of teams and sleighs had already been made by Mr. Papove with A. F. Peterson, a freighting contractor at Fort Nelson.

2. For the initial transport of equipment, food, fuel, hay and oats to the boundary, trucks would be used, travelling to and from Hay Lake over the same route as had been followed the previous winter by Mr. Thistlethwaite's party. Trucks were also to be used for conveying the horses and hauling the sleighs in to the boundary from Fort St. John via the Alaska and Mackenzie Highways.

3. In order to reduce to immediate necessities the loads that would initially be taken in to the boundary, intermittent supply by aircraft during the season was decided upon. A contract was negotiated on behalf of the Commission by

Messrs. Papove and Holloway with an air transport company in Edmonton, whereby the company undertook to carry supplies and equipment and if necessary, passengers to and from the boundary as required during the course of the season at a cost of \$60.00 per flying hour. Suitable landing sites on lakes or rivers near the scene of survey operations were to be made ready as needed by the survey party, and communication with the aircraft operator's bases at Fort Nelson and Hay Lake would be maintained by radio.

4. For incidental and light transportation, a dog team and a motor toboggan would be used, the latter to be purchased from the distributing agents at Kitchener, Ontario.



The Waco plane on Hay River, just after damage to the rear ski

On November 2, Mr. Papove submitted a report to the Commission outlining the proposed arrangements for transport and dealing with other organizational details. His recommendations were approved. On the completion in mid-November of his work on the Alaska Highway he proceeded to engage survey party members, to order supplies and equipment, and deal with other organizational work.

On November 27, a trial flight was made from Fort Nelson to and along the boundary in a ski-equipped aircraft as a final check on the feasibility of the proposed method of air supply under winter conditions, and the pilot signed a statement to the effect that the intended air operations could be carried out successfully. A horse-transport contract was made with A. F. Peterson, of Fort Nelson, B.C., and his outfit of horses and sleighs was conveyed by truck to the boundary during December.

The transport of men and supplies to the boundary was attended by several mishaps and delays. On a flight from Fort Nelson on December 30, the aircraft

carrying men and supplies developed engine trouble which caused a rough landing and damage to the rear ski. It was able to return to Fort Nelson where repair work was undertaken, resulting in a five-day suspension of air transport activities. Subsequently, in flying supplies in from Hay Lake, it was found that the supply of gasoline there was insufficient and a further delay occurred while the deficiency was being remedied. Trucking operations between Hay Lake and the boundary were impeded by deep snow and efforts to speed up transport by conveying horse feed to the boundary by aircraft also proved to be impracticable. The hay purchased at Hay Lake was loosely baled and its conveyance by air was thus so inefficient that it was decided to send one of the horse trains back to Hay Lake to bring it in by road, thus temporarily depriving the survey party of this team. During the trucking operations from Hay Lake, Peterson injured his arm and had to go to Fort Nelson for medical attention, so that the party was without his services for about a week. The motor toboggan was also delayed in transit from Kitchener, Ontario, and did not arrive at the boundary until January 13. The extremely cold weather and deep snow also hampered activities and it was not until well into January that the survey operations got fully under way.

The following description of Mr. Papove's field operations is based on his report to the Commission.



E. N. Davison at work on the line

Composition of the Survey Party

The survey party comprised the party chief, E. N. Davison as assistant and transit man, two chainmen, one leveller, a foreman-picketman, a foreman in charge of reconnaissance and camp movement, a cook and cook assistant, a foreman and two teamsters, two mounders, a rodman, four axemen, a general survey helper, a motor-toboggan operator, and one labourer.

Line Production and Alignment Control

The methods of alignment adopted by Mr. Thistlethwaite were followed in carrying the line northerly from his last monument and the difficulties he experienced in the use of instruments at low temperature again hampered the work. The Wild T2 transit, although carefully winterized before shipment from Ottawa, was too stiff in the movement of its horizontal axis and drum reading for satisfactory use at temperatures below -20° F. This instrument and the Cooke and the two mountain transits were dismantled and cleaned in the field to make them serviceable. After this treatment and with some moderation in temperature, astronomic observations were made with the Wild to a high order of accuracy.



W. N. Papove with the base-line theodolite

Mr. Papove reported his experience with the base-line theodolite as follows:

"Little difficulty was experienced with the six-inch micrometer base-line theodolite so far as its manipulation in cold weather was concerned. Its movement about the horizontal axis is very free and the telescope is particularly good for daytime stellar observations. However, the lengthy period required to read the micrometers and the delay encountered in keeping the reading lenses from frosting over allowed this heavy instrument to become set in its motion about the vertical axis in very low temperatures. The undue pressure required to commence rotation, together with some apparent eccentricity in the vertical motion, made it difficult to obtain satisfactory results with this instrument."

To provide a systematic control for field operations, the line immediately behind the axe crew was roughly chained and laid out into approximate 20-chain bays. Hubs at these points were set by transit and marked with the number

of the next preceding station, adjacent to a monument, with an addition of a plus twenty, forty or whatever the approximate chainage of the bay might be. Subsequently these hubs were accurately tied in by the chainage crews both in the direct and checking operations. Provision of these bays tended to systematize the work of the chainers and any discrepancy in the direct and check chainage could be more readily rectified. The levelling crew was also provided with a control enabling them to work ahead of the chaining crew. The extra time taken up by the line crew in laying out these bays was well worth the effort in the resulting overall efficiency of the field operations.

Difficulties were experienced in keeping a true north alignment of the boundary within the specified tolerance of 10 seconds of arc. In the production process great care was taken in setting stable backsights and making solid set-ups. Observations for azimuth on Polaris were taken at no greater than five-mile intervals, and wherever necessary the monuments were set on a calculated offset in compliance with the required alignment tolerance. It was found advisable to delay the setting of posts till after an azimuth check was made. Instructions called for a minimum of three observations at an observation point, the maximum range in a set being about 5 seconds of arc. During the intense cold of January at the commencement of the survey season, considerable difficulty was experienced in getting acceptable sets of observations. For observing in temperatures ranging to -40° F. enough emphasis cannot be placed on a careful and full winterization of instruments for such conditions.

Line Clearing

The portion of the boundary surveyed during the 1952 winter season runs through flat but thickly wooded country, covered with a heavy growth of spruce of up to 24 inches in diameter and numerous patches of poplar, tamarack, willow and alder. The main determining factor in the rate of progress of the field operations was the rate at which the line could be cleared. From six to eight men were available for cutting operations, but the rate of progress in clearing the line averaged only about one-half mile per day. This resulted from the fact that line-cutting operations had frequently to be suspended while the axe crews were diverted to clearing work on the sleigh road which had to be made for the movement of the camping equipment and which, for the most part, could not be suitably located along the boundary cut-line.

As specified by the instructions, the line was cut out to a sky-line width of not less than six feet and was well blazed on each side. In many places the size and spread of the trees necessitated cutting to a ground width of over 30 feet.

Linear Measurements

Direct chainage in a forward or north direction was done with a steel tape graduated to 400 links, and check chainage in a reverse direction was subsequently made with a 300-foot steel tape. For a full tape length, two sag supports with a 20-pound tension were generally used. Temperatures were taken usually

at the beginning and end of the 20-chain bays previously described and more frequently if any undue delays occurred within the bay. Transfer points were made on plywood boards about 14 inches square, mounted firmly on adjustable leg tripods. Slopes over 5 degrees were read with a transit. A very handy instrument known as the "Angle of Sight Instrument" was used by the rear



Boundary line south from Mon. 118-2

chainman. This instrument can be held in the hand like a clinometer in reading slopes, or it can be set on top of the plywood board if necessary. It is equipped with a low-power telescopic sight and cross-hairs so that it may be used for aligning. Slopes can be estimated to the nearest minute on a drum-reading arrangement. Slope readings were checked by a reverse reading made by the front chainer equipped with a clinometer. Instructions stated that the discrepancy between the two measurements, one in chains and the other in feet, was not to exceed 0.4 feet per mile. The mean of the discrepancies for the season was less than 0.1 feet per mile, and except during the breaking-in period in January, no rechaining was required. Monthly checks of chaining, using a spare tape and applying more accurate methods than called for in the instructions, were made.

Monumenting

The comparatively flat topography made it possible to plant most of the monuments at approximately the maximum 100-chain interval and comply with the intervisibility requirement. A few monuments were set several chains beyond this limit to secure more advantageous positions for them.

Thirty standard pipe posts, specially designed for the boundary survey and resembling the D.L.S. standard post, were set during the season and in each case a reference trench was dug and earth mound made, as specified in the instructions. The position of posts was standardized at 3 links north from the respective transit stations set for this purpose. Bearing trees, whenever available, were added to reference monuments. At approximately 5-mile intervals a standard post was



A completed monument

set in cement. No gravel or sand was available in the area and, as was done in the previous survey, each post selected for this purpose was embedded in neat Portland cement, using a sack to each hole made to receive the post, and back-filling the remaining top portion with dirt.

Levelling

Continuous spirit levels were run along the line. Each portion of the line levelled was check-levelled in a reverse direction, the two results agreeing within the tolerance specified by the instructions. Bench marks consisting of not smaller than 6-inch spikes driven in blazed trees were made adjacent to each monument and generally at the mid-point between monuments to comply with the requirement of a one-mile maximum limit of spacing. Bench marks were numbered continuously and inscribed accordingly.

Magnetic Observations

Seven observations for magnetic declination were made along the boundary at approximately 5-mile intervals. A tubular compass attached to the Cooke transit was used for this purpose.

Photography

Vertical air photographs were carried on the survey. At intervals of not more than one mile identifiable points were carefully pin-pricked and the chainage to each was noted. In the thickly wooded areas it was difficult to pick out sufficient points.

A number of photographs of the survey and transport operations are included for illustrative purposes in this report. Photographs of most of the monuments are filed with the other returns of the survey.



Horse shelter at the camp near Mon. 112-5



A camp move

Camping Equipment

Five 14' x 16' x 4' Norseman wall tents were used for sleeping quarters, one of which was also used as an office. Two 16' x 16' x 6' pyramid tents were used for cooking and dining purposes and as quarters for the cook and his assistant. The pyramid tents were designed to be set up back to back and used as one unit when necessary. Various miscellaneous tents on hand were used for temporary fly camps as needed during the course of the work. During the cold weather shelter for horses was made using tarpaulins.

Transport and Supply in the Field

Transport along the boundary required considerable organization to serve a crew of twenty-three. Food and shelter requirements for the men, horses and dogs involved a large bulk of supplies, and miscellaneous hardware and instrumental items were important factors in the transport movements.

For moving camp, two teams of horses drawing bob-sleighs equipped with racks and a spare horse pulling a toboggan were used. Towards the middle of the season one horse was shot owing to a leg injury, and the party then relied on the two teams for moving. The motor toboggan and the dog team also were used in moving camp.

Camps were spaced about 10 miles apart so that the party could work about 5 miles in both directions from each camp site. On several occasions a temporary

fly camp was established roughly at the mid-point from which a small crew was able to operate for a few days, thus saving themselves long walks to main camps and devoting longer hours to field work.

Prior to a move it was necessary to have a sleigh road cut out and prepared to a point about 5 miles north of the line-cutting operation and about 10 miles ahead of an existing camp. Thus it was necessary for at least three men to work steadily in locating new camp sites and cutting out the roadway thereto. Stumps had to be left quite low to allow sleighs to pass over without impediment. Generally, the boundary cutting could not be utilized for roadway purposes as it was necessary to have the forward camp sites prepared well in advance of line work. Occasionally in the heavily wooded areas of the latter 20 miles of boundary, it became necessary to suspend line-cutting for short periods and to divert the line crew to road-making in order to make the desired moves.

Supplies were constantly relayed up the newly made road as teams went out from the main or fly camps to break trail through the deep snow. For trail breaking it was necessary to unload and use an empty sleigh. In most cases only one team was available for this work as the other was usually occupied in completing the haulage of various supplies from the last preceding camp and from caches along the road thereto, or from airstrips during flights to the boundary. Likewise, provision of wood for cooking and heating was a considerable chore, particularly in the intense cold weather when the daily consumption approached two cords. A small power chain-saw was purchased at the beginning of the season and was most useful in maintaining the fuel wood supply.

After the initial haulage to the boundary, by aircraft equipped with skis, was completed, further visits at approximately two-week intervals were deemed sufficient. The initial landings were made on the northerly crossing of the boundary by Hay River on a stretch immediately adjacent to the boundary. Later a strip about one mile downstream was selected. Subsequently, due to the lack of suitable lakes or rivers close enough to the work, landing strips were selected at about 20-mile intervals. Open areas did exist for making landing strips at closer intervals but Mr. Papove came to the conclusion that, except for emergencies, the hand labour involved in making them suitable for safe operation was too extensive and time-consuming. He decided that it would be more expedient to build up supplies in greater quantity at the available strips and thus increase the bulk to be handled by ground transport.

Two landing strips were made in the vicinity of the boundary, one at approximately Mile 20 and the other at Mile 45 northerly from the Hay River crossing. At Mile 20 a small lake 1,800 feet long was utilized, and at Mile 45 a smaller lake 1,200 feet long was used. The approaches at both ends of each lake were cut out, runways were staked out with small evergreens, and the deep snow tramped down with snowshoes. The smaller lake was suitable only for landing the smaller Stinson aircraft. Take-offs with this aircraft were possible only with very light loads.

On the subject of dropping supplies by air, we quote Mr. Papove:

"Air drops were attempted on two visits of the Waco plane to build up, particularly, our hay supply, and were quite successful. For this operation it was quite important to have bales tightly made up and of a size allowing ease in handling. A few other supplies were also air dropped. Oats dropped in sacks, as also other similar sacked goods, were found liable to burst in contact with the ground. A few ten-gallon drums of gasoline were dropped. It was found that on striking a hard surface, even with snow cover, the welded seams are liable to open. From our experience it is believed that most supplies could be successfully dropped from the air if properly prepared in suitable containers to cushion the shock on contact with the ground, and provided the approaches to the drop area are cut out, allowing the plane to descend as low as possible. The Stinson aircraft was used successfully towards the latter part of the season to haul some of the smaller, more tightly baled bundles of hay, when these were placed over heavy articles of small bulk, such as canned goods or cement."

Close contact was maintained with the Western Airmotive pilot who serviced the camps and his co-operation was of the best order. At the end of each visit, the position of the next landing strip was selected from air photographs and a reconnaissance flight was made to this location to check its suitability. If it appeared satisfactory, red flags attached to poles were then air-dropped over the selected area so that the ground crews later would not be in doubt as to the proper lake. One of the foremen in charge of the advance operations accompanied the pilot and the party chief on these flights to familiarize himself with the area. The best positions of the next camp sites were also observed during these flights.

Despite this reconnaissance from the air and the subsequent use of a compass on the ground and reference to air photographs, the scouting crew at times had considerable difficulty in finding the selected spot; the ground being quite level with no vantage points or definite landmarks adjacent to the boundary. In the thickly wooded areas it was possible to miss the desired spot by a very short distance.

Mr. Papove described this problem as follows:

"To give some idea of the difficulties experienced in this respect, it took almost a week of intensive scouting on snowshoes by three men, two of whom were local men and generally familiar with the country we were in, to find the lake, previously mentioned, at Mile 45, where a landing strip had been selected. Our main camp was about ten miles southerly from this lake. A dog team accompanied the party with provisions, bedding, and a light tent, as the men camped out. It was important to find this lake as early as possible as a plane was expected towards the end of the week and some work was necessary to prepare the airstrip and cut out the approaches. Moreover, a quantity of hay had been air-dropped on this lake and our supply at

camp by the end of the week was dangerously low. Fortunately, the lake was found and the airstrip was prepared in sufficient time, but not until a prolonged search had been made."



Scouting party at the site of the proposed landing strip



Hauling hay by dog team, about 45 miles north of the Hay River crossing

The dog team, consisting of five dogs, was most useful on many occasions, particularly to the advance scouting party. Towards the end of the season the team was used to haul the supply of hay air-dropped over the Mile 45 lake. This obviated the use of horses and the necessity of cutting a wider trail for the bob-sleighs.

The motor toboggan, when in top running condition, proved to be a very useful machine. Because of its much greater speed in comparison with other means of travel on the ground, it was used mainly on various odd jobs, such as checking the line, setting and levelling in posts, taking observations, etc. At times it was used successfully for transporting crews to work and for hauling



W. N. Papove and E. N. Davison with
radio equipment



Motor toboggan in use

supplies in camp moves. Previously prepared horse trails along the boundary were ideal for use by the motor toboggan. Its disadvantages were described by Mr. Papove as follows:

"Our main trouble with it was the lack of proper repair parts when needed. The clutch lining gave us considerable trouble and, until proper materials were flown in, we improvised spare clutch parts, using leather and finally wood of cheese rounds. Chain links kept breaking and at times we were hard pressed to improvise parts to keep the machine running. For a considerable time the engine lacked power, which was remedied after we ground the valves in the field. With proper care and the provision of sufficient spare parts a machine of this type is a worthwhile addition to a winter survey party's transport equipment."

Radio Communication

To facilitate supply movement and for general contact with the outside, two forestry-type radio transceivers were used for sending and receiving messages by voice. One of these was set up at the Hudson's Bay Post at Hay Lake, and a daily schedule was maintained. A daily schedule was also set up with the Radio Division of the Department of Transport at Fort Nelson, B.C. A Hallicrafter radio was on hand to receive time signals and also messages from Fort Nelson which could not be picked up with the transceiver set. Reception was particularly poor at first but improved considerably later. It was also possible to communicate with aircraft circling the camp.

Conclusion of Field Operations

The withdrawal from the boundary was done quickly and efficiently. A 12' x 12' log ground cache was made at approximately 34 chains short of Mile 375. In this cache were stored left-over non-perishable foods, hardware, motor toboggan chassis and miscellaneous equipment. Instruments and radios on loan were shipped out to their respective points of origin as were tents, sleeping robes, parkas, motor toboggan engine and power chain-saw.

On the morning of March 28th, two Stinson planes came in and men were flown out that day, mainly to Fort Nelson and some to Hay Lake and Upper Hay River. On the following day, baggage, instrumental and other equipment were flown out by the same planes to Fort Nelson. The horses and dog team proceeded on their own to Hay Lake and the Mackenzie Highway.



Stinson aircraft used to take out the party members

Summary of Progress

During the season 37 miles of new boundary were surveyed, monumented and levelled, approximately one mile of previous survey was retraced, and one mile of line beyond the last monument was cut out. Thirty-one monuments were built and eight sets of azimuth observations were taken. The surveying operations covered a period of approximately $2\frac{1}{2}$ months and ended about 15 miles south of the point where the Petitot River crosses the boundary. At this point the line emerges from an extensive, thickly wooded area into terrain considerably more open, and giving promise of greater progress in the extension of the boundary survey.

Throughout the season the morale and co-operative spirit of the survey party were good, and the work was at no time impeded by labour troubles. The

only injuries or illnesses serious enough to cause inconvenience or delay in the operations were the eye injury sustained by the leveller, who was replaced at mid-season, and the illness of the cook, who was replaced by his assistant. All members of the party were covered in respect of workmen's compensation by the provisions of The Government Employees Compensation Act, 1947

WINTER OF 1952-53

The Commission met on August 25, 1952, at Victoria to make plans for continuation of the survey during the next winter. On that occasion it also approved Mr. Papove's report on the 1951-52 season's work.

As Mr. Papove had made other commitments for the 1952-53 winter season, it was agreed that Mr. George Palsen, D.L.S., A.L.S., of the Legal Surveys Division, Department of Mines and Technical Surveys, be placed in charge of the projected field work. He had already been asked by Mr. Waugh, Surveyor General of Canada, to submit tentative proposals regarding the further conduct of the survey and had recommended that the work be commenced in mid-November, using dog teams for transport on the line. The relatively open country north of Township 116 offered promise of rapid progress with this lighter type of transport.

The Commission agreed to employ Mr. Palsen and approved his proposed plan of operation and estimate of costs. On October 9 formal instructions for continuation of the survey were transmitted to him. In their technical details these instructions were the same as those previously given to Mr. Thistlethwaite and Mr. Papove, with the addition of specific directions for establishing and marking the terminal point of the line. Mr. Palsen was also directed to make such measurements as might be necessary to relate his elevations and the azimuth of the line to those of the Alberta-Northwest Territories boundary which was surveyed by C. B. C. Donnelly, D.L.S., A.L.S., during the previous winter to a point estimated to be a few chains east of the Alberta-British Columbia boundary terminus.

Mr. Palsen, with his assistant, John Fox, also of the Legal Surveys Division, arrived at Edmonton on October 28. Having made arrangements with the Hudson's Bay Company for the shipment of supplies to Upper Hay River, and with Associated Airways Ltd. for the transportation by air of men, supplies and equipment from Upper Hay River to an Imperial Oil Limited landing strip about 25 miles from the boundary, Messrs. Palsen and Fox proceeded to Peace River where they spent three days in checking and arranging for the shipment of supplies and equipment and in engaging men who had worked previously with Mr. Palsen on northern surveys. Mr. Fox went ahead to oversee the transport and delivery of survey equipment from Peace River and Hay River to Upper Hay River and Mr. Palsen proceeded to Manning where he arranged to hire a tractor train which would join the party in the field on December 15. It was intended

to use the tractor outfit mainly on the British Columbia-Northwest Territories boundary which Mr. Palsen had instructions to survey immediately after completing the Alberta-British Columbia boundary.

On November 2, Mr. Palsen went on to Fort Vermilion where he engaged a cook and other party personnel. John Fox arrived there from Upper Hay River on the 3rd and reported that all supplies had been delivered at the latter place. Up to this time the weather had remained mild and the ferry at Fort Vermilion was still operating through flowing ice in the Peace River.

At Fort Vermilion, eight dog teams and drivers were hired, and all dogs were vaccinated against rabies, which at that time was widespread in northern Alberta. On November 8, twenty men, the dog teams and a quantity of supplies and baggage were transported by truck and car to Upper Hay River. From that point the men, dogs, equipment and supplies were flown during the next few days to the Imperial Oil Limited landing strip. By November 17 the full complement of men, supplies and equipment was assembled in camp at the landing strip. There the supplies were sorted into four lots for transport by aircraft to caches at previously selected points near four lakes along the boundary line.

The movement of the survey party and equipment by dog teams and truck over the 25 miles from the landing strip to the end of Papove's line occupied the next 10 days. Progress was slow because of continued mild weather and insufficient snow for effective dog team operation. On the 20th, the daytime temperature rose to 40° F. and by the 21st the snow had practically vanished. These conditions continued until the 29th and attempts to haul normal loads by dog sleigh over the bare ground resulted in broken sleighs and harness.

On November 28, however, the starting point of the survey was reached. The line between Papove's last two monuments was cleared, chained and levelled and after a dog sleigh trail had been cut farther south to the cache left by Papove about 4 miles from the end of his line, the equipment and supplies stored there were brought to camp.

The aspects in which this survey differed markedly from the previous surveys were those of transport, terrain and weather conditions, all of which combined to promote much speedier progress. Throughout the first two weeks of December temperatures ranged from zero to 34° F. and a little snow fell. December 14 brought showers of rain. Clear weather prevailed almost continuously thereafter, with temperatures a few degrees above or below zero until January 6. A spell of cold clear weather followed, with temperatures down to -55°, but by January 19, daytime thermometer readings were again above zero, and remained there until the survey was completed on January 22. During the whole period only occasional snow flurries were experienced and as can be seen from the photographs accompanying Mr. Palsen's report, the snow on the ground was never deep enough to necessitate the use of snowshoes. The ground over which the

line ran was level or only gently rolling, the muskeg areas crossed were relatively small, and extensive tracts of forest growth had been recently burned, all of which contributed to easier opening of the line.



Camp at the Hay River landing strip



Establishing camp at the Imperial Oil landing strip

These conditions and the virtual absence of the discomforts and difficulties associated with intense cold and deep snow, together with the greater mobility of the transport used, enabled the survey work to be carried forward rapidly.



Lunch break

The survey operations were attended by some labour difficulties and occasional illness, but these did not cause serious delay in the progress of the work. On December 14, the leveller resigned and until he could be replaced Mr. Fox took over the levelling and Mr. Palsen did the transit work. It was not until after the survey of the Alberta-British Columbia boundary was completed and the party had moved to the British Columbia-Northwest Territories boundary that this vacancy was filled by the arrival of P. Timoschuk, D.L.S., A.L.S., who was sent from Ottawa to serve as leveller for the remainder of the season. The loss of a chainman through illness in mid-December and of the rodman at the end of the month made it necessary for Mr. Palsen to spend some time in training other men for that work. On January 12, four other men resigned, but their departure did not seriously affect the progress of the work.

Progress was made at an average rate of a little more than a mile a day after the work began on December 2. The end of the line was reached on January 21, a distance of 50.2 miles having been surveyed. On the 22nd and 23rd the unsurveyed portion of the Alberta-Northwest Territories boundary was measured and levelled and connected to the terminal point of the Alberta-British Columbia boundary.

The survey party then proceeded to run the British Columbia-Northwest Territories boundary, west from the northeast corner of British Columbia.

On March 9, the survey party returned to its main supply base near a lake about 16 miles west of the Alberta-British Columbia boundary where, by pre-arrangement, it awaited the arrival of the aircraft which was to convey the men and equipment to Fort Vermilion. At that time, snow was falling daily and an airplane which flew over on the 10th was unable to locate the camp because of



Light snow cover on the line. G. Palsen carrying transit

poor visibility, and returned to its base. On the 13th a Norseman aircraft flew in from Hay River and took two loads of men and baggage to Fort Vermilion. On the 14th, a Bellanca arrived from Peace River and five loads of men, dogs and equipment were taken to Hay Lake and Fort Vermilion. The air transport operations were completed on the 15th and after paying the men hired locally, and directing the packing of equipment at Hay Lake for transport by truck to Upper Hay River, Mr. Palsen went to the latter point and arranged for the storage there of certain equipment and supplies. He left Upper Hay River on March 26 and returned to Ottawa by way of Edmonton.

CHAPTER III

GENERAL DESCRIPTION OF COUNTRY

The portions of the boundary surveyed in 1950-51 run through country described in Mr. Thistlethwaite's report as follows:

"The area traversed by the survey carried out in 1950 encompasses only two noteworthy topographical features. These are the Fontas and Hay Rivers.

"Fontas River is unimposing at the boundary crossing. It crosses near the centre of Township 103 in a general northwesterly direction. The valley at this point is some 40 feet deep. Within the confines of the valley the stream bed, here only 50 feet wide, follows a tortuous course, through innumerable meander loops.

"At the time of crossing, August 1, the flow of water was practically negligible. The summer season having been very dry, the river consisted merely of a series of stagnant pools connected by trickles running through the coarse gravel of the river bed. No attempt was made to estimate the amount of water flowing. At more normal stages, judging by the appearance of the banks, the river would have a depth of four or five feet. The current velocity would not be high—the river appears to be of rather placid nature at this point. As would be expected, the water was found to be clear and there was relatively little colouring.

"The immediate vicinity of the river valley is quite pleasant in nature. The ground is clayey and firm underfoot. The more or less general fringe of aspen growth forms welcome relief from the spruce found everywhere else. The valley bottom is in parts wooded with heavy growths of spruce ranging up to 24-inch diameter.

"Hay River, at its southern crossing of the boundary, is a much larger stream than the Fontas. It flows westerly across the central part of Township 108, turns north and recrosses the boundary flowing easterly, some 25 miles to the north. It flows in a very well-defined valley which is, at the boundary crossing, one-half mile wide and 110 feet deep. The banks of the valley are quite steep. The river channel proper is 120 feet wide. Apart from its size it is distinguished from the Chinchaga and Fontas Rivers to the south by its older character. Meandering is much less pronounced—in fact there are stretches of a mile or more in length which show but little bending.

"The flow at September 19, was inconsequential. The water present consisted of trickles running from pool to pool through the gravel and boulders of the stream bed. No attempt was made to estimate the flow. Mid-channel depth at normal stages would be of the order of 6 to 8 feet, with numerous shallows.

“Hay River, like all the other streams encountered this season, presents firm ground along the limits of its valley. As one proceeds inland from the river, swampy ground or muskeg is encountered. The valley itself is quite attractive



Fontas River at the boundary

by reason of the varied character of the growth. Spruce, jack pine, aspen, balsam and willows all flourish on the bottom land

“A number of minor streams and watercourses were crossed during the season. All except the most southerly few of these flow in a westerly direction and,

in 1950, carried very small amounts of water. Almost all show evidence of beaver activity. In some cases, particularly in the region lying just south of Hay River, we found that the drainage of the country is strongly affected by the work of these animals and some streams appear to have been diverted from one channel to another.



South crossing of the Hay River

"The boundary crosses the divide which separates the Hay and Slave River systems from that of the Fort Nelson River. The divide coincides with a very pronounced height of land situated near the south boundary of Township 100. It is the highest ground encountered in 1950 and reaches an elevation of 3,360 feet on the line. It is crossed again somewhere between Fontas and Hay rivers at an elevation of about 2,200 feet. However, at the northern crossing its character is so indefinite that it cannot be located precisely from present information. It apparently does not coincide with the highest point of the boundary profile between the two rivers.

"The terrain traversed ranges from hilly land of prominent relief to flat swamp and muskeg. In the first 14 miles from Township 97 the general level of the ground rises. The surface undulates in a series of ridges whose crests rise as much as 200 to 350 feet above the valleys between, until the height of land, at elevation 3,360, is reached in the southern part of Township 100. The general

attitude of the ridges is northwesterly. The drainage here is well defined and flows southeast. The surface varies from firm clay soils on the slopes and crests to moss and muskeg in troughs. Thick moss cover is found on some broad, gently sloping summits. The surface is wooded throughout. On the higher ground are found heavy stands of spruce accompanied by aspen and jack pine. The lower areas support small spruce with occasional jack pine and aspen ridges.

"From the southerly height of land mentioned above, the general level of the ground falls continuously to the north until the valley of the Fontas River system is reached. The descent is abrupt at first—the ground recedes some 600 feet in the first mile. For the next 12 miles, to the southern part of Township 102, the general ground level falls at the rate of about 20 feet per mile, with some crests rising 100 to 200 feet above the general gradient. This area of moderate relief extends east and west. The drainage pattern is clear-cut and all watercourses drain to the west. Muskegs are local in extent and confined to the vicinities of the streams and watercourses. The surface is wooded throughout but badly scarred by burns of different ages. Dense clumps of spruce up to 24-inch diameter are encountered. Deciduous growth, consisting of aspen, balm, willow, birch and alder is fairly extensive in this section. There is much scrub spruce and jack pine second-growth.

"In Townships 102, 103 and 104, the boundary traverses the valley of the Fontas River system. The ground elevation decreases gradually 300 feet to Fontas River valley banks and then rises slowly about 70 feet to a secondary height of land in Township 104. The terrain is almost devoid of relief along the boundary but ridges of moderate height lie to the westward. This area is predominantly swamp and muskeg, varying from open bog and grassy swamp south of Fontas River to deep moss, mainly wet, north of the river. Low, dry ridges are encountered here and there. Forest cover varies from spruce up to the 24-inch diameter found along water courses and on the higher ridges lying to the west, down to scrub spruce and tamarack in the muskeg and swamp areas. Jack pine and aspen of moderate size are found on the higher ground. There is also extensive willow growth in the wetter areas.

"From the height of land in Township 104 north to Hay River in Township 108 the terrain descends in a regular manner and the only outstanding relief encountered is that marking the valleys of two creeks and Hay River. The total drop to the banks of Hay River valley is 780 feet.

"The chief characteristics of this area are the lack of conspicuous relief and the diffuse drainage system. A series of drainage channels crosses the boundary flowing westward. However, beaver activity has so encumbered most of these channels that they have become merely swampy seepages with occasional shallow stagnant beaver ponds. The country between the channels is interlaced with more or less wet swamp or muskeg areas which drain imperceptibly toward the more prominent channels. The dry ground between the swampy areas takes the

form of low ridges and knolls. Beaver dams and ponds are found in the central areas between the principal drainage channels and it seems that beaver activity has contributed to the swampy nature of some of the terrain.

"The area is wooded throughout. However, it appears that the character of the growth changes as we go north, from predominantly coniferous to deciduous woods. Mossy or muskeg areas generally support only scrub spruce with the odd tamarack. Occasional small stands of heavy spruce are found with diameter up to 24 inches. Jack pine ridges are more numerous. In Townships 107 and 108 there are extensive stands of aspen and balsam, with some birch. The swampy drainage areas support prolific growths of willow and alder.



Balm of Gilead, Township 98

"By good fortune, the season of 1950 was extremely dry. Had it been wet it is doubtful if the pack horses would have been able to carry out the necessary transportation for the survey party. As it was, the establishment of transport routes in the Fontas River area was difficult. There are pack trails along the Fontas and Hay rivers and one or two of the larger streams which do not show signs of extensive recent use. Though it is generally conceded that it is relatively easy to find suitable footing for horses along the banks of streams and water-courses, it is quite a different matter to traverse the country lying between streams since this is usually swampy ground or muskeg. In view of the fact that the boundary crosses the drainage of the country more or less at right-angles, it is clear that the most unfavourable conditions were imposed upon the task of transportation

"Animal life cannot be said to be prolific in the area. Though there are signs of moose and black bear almost everywhere, very few specimens were seen. Grizzly bear tracks were said to have been seen by members of the party but there is some doubt as to the accuracy of the observation. Locally, the scarcity of big game is attributed to the ascendancy of timber wolves.

"The natural resources of the area would seem to be restricted to fur. Trap lines were encountered all through it. Although many do not seem to have been worked recently, the indication is that the country has been of considerable interest to trappers in the past. The abundance of beaver signs should lead to continued interest. Beaver, muskrat, marten and squirrel were the only furbearers seen.

"The search for oil has extended to the area and during the season two exploration parties were contacted.

"Timber resources are restricted to random stands of good spruce whose continued existence is subject to the unchecked vagaries of fire.

"Forest fires have been active throughout the area during the past. Burns of different ages were encountered everywhere. The most extensive single area of recent activity lies in Townships 99 and 100. Here the boundary traverses an almost uninterrupted expanse of standing *brulé* for five miles. During the season of 1950, fires were visible from the survey camp at all times. For a long time four distinct fires surrounded the party and were a source of considerable apprehension under certain wind conditions. It is very probable that some of the boundary surveyed this year was burned over after the passage of the party.

"Between the south and north bends of Hay River, the terrain traversed by the boundary is almost featureless. After crossing a secondary height of land contiguous to the Hay valley at elevation 1,540 feet, the terrain descends northward in a very uniform manner. The only notable relief is that provided by the valley of the Burnt River, a flat notch dropping some 70 feet below the general descending plain. The gradual descent continues northward to the north bend of the Hay River in Township 112. Here the river channel has no well-marked valley, in contrast with the south bend. It exhibits an apparently younger nature here and flows in large meander loops, with many oxbows. The river is somewhat larger at the north bend and is 243 feet wide at the boundary crossing. It falls 256 feet in its semicircular loop to the west of the boundary. The general drainage of the area contained by the loop is toward the northeast and is concentrated chiefly in the Burnt and Little Hay rivers which join the Hay some distance east of the boundary. Little Hay River is an insignificant stream with no notable valley.

"The terrain is wooded throughout. The growth ranges from 24-inch spruce and tamarack through spruce and poplar more commonly 8-10 inches in diameter down to the ubiquitous swamp spruce and willow. There are many burned areas of different ages. The most effective barriers to line-clearing were some

patches of heavy spruce deadfall which would have been very difficult indeed to open up by hand labour. There are wide belts of muskeg terrain which extend laterally east and west from the line and are covered with swamp spruce. The boundary traversed the widest part of a belt of very dense spruce growth, ranging up to six and eight inches in diameter, which straddles the Little Hay River.

"Some current trapping activity was observed. Indications are that, barring perhaps beaver, there is not a great deal of animal life in the area. While moose



North crossing of the Hay River

certainly exist, only one specimen was seen. Lynx are taken. Rabbits were observed to be numerous. It is not to be expected that members of the winter survey party would observe much wild life or sign thereof due to the continual din of the machinery used.

"The whole area traversed during the summer of 1950 and the following winter is unsettled and very little is known about the country. The only sources of information are trappers whose knowledge, generally, is restricted to the immediate vicinities of particular trails and trap lines. Since these usually follow streams and watercourses, the terrain lying inland may be said to be unexplored"

Mr. Papove's description of the country through which his party worked during the 1951-52 season follows:

"The portion of the Alberta-British Columbia boundary surveyed during the 1951-52 winter lies immediately north of the Hay River at its north crossing of the boundary. It commences $2\frac{1}{2}$ miles south of the north boundary of Township 112 and continues on to approximately 4 miles within Township 118.

"Generally speaking this area has no prominent physical features. The drainage is towards the southwest and into the Hay River which itself flows easterly. Various small creeks which are intersected by the boundary flow in a general southwesterly direction to make up what is shown on the National Topographic Series Sheets 94 N.E. and 84 N.W. as the Shekilie River. This stream crosses the boundary within Township 116 and is known locally as Rabbit Creek. This creek is about 25 feet wide here, shallow and meandering. Five small creeks cross the boundary in Township 117 and four in Township 118.



Second-growth spruce, Township 118

"Ground elevations rise gently towards the north giving a rise of some 460 feet in 37 miles. The rise in the northerly 2.5 miles of Township 112 is about 11 feet. In Townships 113, 114, 115, 116 and 117 the rises in elevation are approximately 31, 74, 57, 53 and 118 feet respectively. In approximately 4 miles of Township 118 the rise is 119 feet to the last monument set. In Township 118 the character of the ground topography changes from a uniform flat-appearing surface to a slightly rolling one as the height of land is approached separating the Hay River drainage system from the Petitot River system to the north.

"The country from Township 112 to and including Township 115 is particularly swampy in character. There are a considerable number of small lakes,

ponds and sloughs in this area. In Township 116 small water areas are found in great numbers three-quarters of a mile west from the boundary and Townships 117 and 118 have only a few such areas. A considerable number of sloughs have hay of a quality suitable for horse feed.

"The country is well wooded throughout, with burnt areas found in Townships 114, 115 and 116. From Township 112 to and including Township 115 the



Axemen and party chief on the line

swamp and muskeg areas are characterized by thick patchy growths of spruce, tamarack, willow and alder with numerous openings. Some spruce here attain 16 inches in diameter. In the higher ground are thick stands of poplar and some scattered birch up to 8 inches in diameter. From about Township 116 northerly to the end of the surveyed line there are mainly thick stands of spruce with some trees attaining 24 inches in diameter. With the spruce are also scattered stands of tamarack, poplar, birch and willow. Some jack pine is found in the vicinity of the last monument set. Here also the country commences to become more open.

"The soil in the swampy areas is generally of the peat and muck type. In the higher portions clay is usually found under a shallow humus layer. Township 118 the first small boulders were encountered in the clayey soil.

"Moose are abundant and beaver, muskrat, lynx, marten, wolf, fox, squirrel and black bear inhabit this region. Trap lines were encountered throughout."

The following extract from Mr. Palsen's report describes the country in the vicinity of the northerly 50 miles of the boundary:

"The season's work began at Mile 378+71.123 on the 120th meridian. From this point northerly the meridian passes over gently rolling country draining northwesterly into Petitot River. The country is partly burned over and there are large areas of dead standing spruce and deadfall and numerous scattered bluffs of green spruce of merchantable size. There are also small areas of spruce muskeg, and according to the soil horizon this area is of glacial origin. The country from point of commencement of the survey for 22 miles to Petitot River, on either side of the meridian, has little agricultural value.

"The Petitot River crosses the meridian in Mile 401. The valley is steep and averages a half mile in width, while the river channel averages 300 feet in width. The depth of the water varies with the season from two to five feet. The river flows swiftly over its bed of boulders with numerous rapids. On the north side of the river the valley is burned over and strewn with dead standing spruce and deadfalls to 24 inches in diameter.

"North of the Petitot River for 10 miles the country is level with some large areas of muskeg and is dotted with numerous small lakes. From this point to the 60th parallel is rolling country, burned over, the ridges covered with dead standing spruce, pine and second growth. Scattered areas of muskeg exist. A few eskers were seen. Most of this country drains west and south to Petitot River.

"The Indians trapping in this area are from Upper Hay River and Hay Lake, belonging to the Slavey tribe. They cannot understand Cree nor can a Cree Indian understand their language

"There were many signs of moose and caribou in the country passed over during the season.

"The best hunting ground is on the Petitot River and its tributaries. It appears that in the past game was much more plentiful than now as there are numerous paths that have been cut deep in the moss. The burning of the country has had much to do with scattering the game. There are many fur-bearing animals . . . such as lynx, marten, mink, muskrat, fox and beaver, and Upper Hay River and Hay Lake are considered two of the best fur posts that the trading company has.

"There was no rock found in place nor any mineral."

CHAPTER IV

INSPECTION OF THE SURVEYED BOUNDARY

On January 26, 1953, the Commission held a meeting at Ottawa. It was not then known that the survey of the boundary had been completed recently by Mr. Palsen, but it was evident that the field work would be completed during that winter and thus consideration was given to the preparation of final plans of the boundary, the Commission's report and the legislation that would require enactment in order to confirm the position of the boundary as surveyed. It was agreed that the preparation of the final plans be undertaken by Mr. A. S. Thomson of the Department of Lands and Forests at Victoria, under the general supervision of Mr. Stewart who had retired as a Commission member and had been replaced by Mr. Andrews.

The matter of inspection of the surveyed boundary was also considered, but because of various uncertainties as to possible arrangement, no decision was made.

In June, however, circumstances arose which offered a favourable opportunity of inspecting the surveyed line. A topographic survey party in the service of the provincial Department of Lands and Forests was then working in the Beatton River area of northeastern British Columbia and had at its disposal a helicopter. Mr. Andrews suggested that Mr. Stewart be engaged to undertake an inspection, using this machine on a loan basis as transportation. This was agreed to and Mr. Stewart made the inspection during August. An account of this work is given by the following extracts from his report:

"I left Victoria on August 1 and arrived back . . . on August 19. In the interval, retracements were made at four places along the boundary as required by your instructions. This was made possible by the co-operation of the B.C. Topographical Survey party in charge of Mr. E. R. McMinn, B.C.L.S., which was operating out of a camp on the Beatton River, a few miles south of the Beatton River airstrip. Mr. George New . . . was assigned as my assistant, and all equipment (excepting instruments) and provisions were supplied by Mr. McMinn. This equipment included a two-way radio, which proved very useful in arranging the helicopter flights. The helicopter of Okanagan Helicopter Ltd., on contract with the provincial topographic party, was loaned to us when required.

"Shortly after my arrival at Beatton River camp, Mr. McMinn, Mr. Bill McLeod, who was in charge of the helicopter, and I discussed the best way to use the aircraft on my work. It soon became apparent that it would require more than the estimated 28 flying hours to make the inspection as

planned. Some time could be saved by revising my progress to three landings in place of four as originally intended, with a short flight from the Petitot River to the end of line on the day we were returning to base. The program was altered accordingly. Use was to be made of the Topographic Division's Beaver aircraft for putting in gas caches for the helicopter at two lakes suitable for seaplane landings.



At Upper crossing of the Hay River

“With the exception of a slight delay in completing our first move from Beatton River to the upper crossing of the Hay River, no transportation difficulties were encountered. The long distances from base camp were covered with the helicopter by making use of these gas caches and by transporting a full load on their “out” trips when no passenger or equipment was carried. A full time radio operator at base camp insured radio contact whenever radio communication was possible.

“Although the actual retracements made for inspection purposes were rather meagre, a very good look at the boundary was obtained from the helicopter flying just above tree top height at the comparatively slow speed of 60 miles per hour. Inspection of the physical character of the line from helicopter is probably as good as an inspection on the ground on foot. The monument and trenches cornering on the line were visible in most instances, especially in muskegs and in the clay soil where the growth of green and young trees have not as yet covered them. The clay not used in the

building of the mound and which was scattered around, also proved useful in locating the monuments. The cutting of the skyline was observed from the helicopter and in many places blazing could be seen.

"However, the inspection of the technical side of the survey could not be carried out from the air. This was accomplished by chaining between monuments and by taking azimuth observations on Polaris on at least one stretch surveyed by each of the three surveyors on the boundary work.



View north from Monument 108-2



Monument 108-3

"A summary of the results are as follows:

(1) The first camp was located at the upper crossing of the Hay River and the 120th meridian. Here the boundary was chained from Mon. 108-2 to Mon. 108-4.

Mon. 108-2 to Mon. 108-3 surveyed by R. Thistlethwaite—summer 1950.

R. Thistlethwaite—94.824 ch.

N. C. Stewart—94.830 ch.

Diff.— .006 ch.

Monuments good and according to instructions, blazing, skyline, and intervisibility good.

Mon. 108-3 to Mon. 108-4 surveyed by R. Thistlethwaite—winter 1950-51.

R. Thistlethwaite—84.444 ch.

N. C. Stewart—84.435 ch.

Diff.— .009 ch.

Blazing poor, intervisibility and monumenting good, line cleared by bulldozer—very good.

A set of azimuth observations were taken at Mon. 108-2. Mean of 5 observations by inspection survey— $359^{\circ}59'57''$

Azimuth by R. Thistlethwaite— $359^{\circ}59'54''$

Targets at Mon. 108-3 and Mon. 108-4 are dead on line from Mon. 108-2.

(2) The second camp was placed at the lower crossing of the Hay River.

Mon. 112-4 to Mon. 112-5 surveyed by W. N. Papove—winter 1951-52.

Chainage by inspection survey—99.937 ch.

W. N. Papove—99.929 ch.

Diff.—.008 ch.

Mean result of four azimuth observations taken at Mon. 112-5 gave bearing of line 112-5 to 112-4 to be— $179^{\circ}59'50''$

by W. N. Papove — $179^{\circ}59'54''$

Mean angle read at Mon. 112-4 between Mon. 112-3 and Mon. 112-5 equals $180^{\circ}00'05''$.

Monumenting, intervisibility, blazing and skyline good.

(3) The third camp was at the crossing of the boundary and the Petitot River.

Mon. 122-1 to Mon. 122-2 was surveyed by Mr. G. Palsen—winter 1952-53.

Chainage by inspection survey—99.6612 ch.

G. Palsen —99.6480 ch.

Diff.—.0132 ch.

Mean of seven azimuth observations taken at Mon. 122-2 gave bearing of line 122-2 to 122-1— $179^{\circ}59'58''$

by G. Palsen — $180^{\circ}00'00''$

Line well cut out, monumenting good, intervisibility poor, blazing scant."

"The flatness of the country, especially between the upper crossing of the Hay River and the end of line is noteworthy. As one goes northerly the forest growth becomes less and the open spots increase. A few years ago I flew up the 120th meridian and that section north of the Petitot River was covered with water, while this year there was very little water in the muskegs.

"Another conspicuous feature was the great number of bulldozed roads on the Alberta side of the boundary. Adjacent to the boundary south of Lat. 58° there were also numerous winter roads, and on the ridges several of McMinn's triangulation towers were seen.

"As a final result of this inspection, it is my opinion that the survey, although made under very difficult circumstances, has been very well performed, and I would suggest that the three surveyors who were in charge of the work should be highly praised for a job well done in a difficult terrain."

EXTRACTS FROM DIARY

August

Thursday 6 Pilot Bill McLeod took New and half of outfit to the Upper Crossing of the Hay River and the 120th meridian. One stop was made at a gas-cache lake (near boundary in Alberta) established by the B.C. Topographic Division "Beaver" aircraft, and Pilot McLeod returned to the cache lake to await my arrival. In the meantime McMinn drove me to Charlie Lake; from which point I was to be taken by the "Beaver" to this cache lake, transferred to the helicopter and flown north to Upper Crossing of the Hay River. However when the "Beaver" arrived at Charlie Lake it was found that it had engine trouble and required some work done on it. We returned to the Beaton River camp. Pilot McLeod sensing that something was wrong, also returned to the Beaton River camp. George New was contacted by radio, and advised about my delay.

Friday 7 I left Beaton River camp in helicopter (Pilot McLeod at the controls) at 8 a.m. Took on gas at Stalag triangulation Station. Arrived at Upper Crossing of Hay River and 120th meridian at 9:55. The country between Beaton River camp and 120th meridian is an area of dead and dying lakes, now mostly muskeg. Numerous bulldozed roads were crossed. One road parallels the boundary some 5 to 10 chains inside Alberta. The area through which the 120th passes is not so full of muskeg as area to west. The boundary line appeared from the air to be cut according to requirements. Many of the monuments were visible. The boundary line looks quite secondary to the bulldozed roads which are wider, have no stumps or down logs. The bulldozers penetrated and removed part of the top soil, hence it will take a long time to cover them with a new growth. . . .

New and I commenced retracing the boundary between Monument 108-2 and 108-3, chaining approximately 40 chains northerly from Monument 108-2, which we found in good condition and built according to specifications. The line is well blazed with B.C. blazing on the west and Canada

blazing on the east side of the line, and has a clear sky line. Considerable young growth of willow and poplar had to be slashed before chaining could be accomplished.

Weather—very hot, temperature to 85°. Thunder storm developed from 6:30 p.m., but only a few drops of rain fell.

Saturday 8 We completed chaining from Monument 108-2 to 108-3 (Mr. Thistlethwaite's summer survey) and from Monument 108-3 to 108-4 (Mr. Thistlethwaite's winter survey).

We waded the brown water of the Hay River, up to the knees. At Monument 108-3 there is a concrete monument, trench and mound in good condition. Winter Monument 108-4 is also in good condition. We tried for stellar observation on way back to camp, but it was too dark to see signals. We got a time star.

Monument 108-3 and Monument 108-4 are not inter-visible, but 108-2 is visible from Monument 108-3 and also 108-4. We reached our camp on the Hay River after 10 p.m.

On viewing Thistlethwaite's bulldozed line of his winter survey (1950-51) it is evident that the bulldozed line makes a better boundary than that cut out by axemen. It provides a more suitable medium for the instrument work and for chaining and will not be obliterated as rapidly. In winter when the ground and muskegs are frozen it will provide a good means of travel. The monuments are by-passed by the bulldozers.

One thing missing in the bulldozed line was sufficient blazing, due to the difficulty in getting to the trees over the piled-up debris and snow.

Weather—very warm in middle of the day—cool at night. Some flies—but not bad.

Monday 10 Packed up everything but radio. Waited for helicopter. Radio reception nil. A flock of mallards, a black bear with two cubs, and 10 Canada geese visited us, while we were waiting for the helicopter. Pilot Art Coles arrived at 11 a.m. Moved George New and half of the outfit to lower crossing of the Hay River. The helicopter returned and took me and balance of outfit to lower crossing of Hay River. It was fortunate that a space had been cleared on the north bank of the river, large enough for a helicopter landing right on the line. A few additional trees were cut by New to make the take-off safe. . . .



R. Thistlethwaite's winter line and bulldozer road. View south across Hay River



View north from Monument 108-4

After putting up a target over Monument 112-4, which is in a muskeg, and not a good place for observing due to the shaky soil, we continued northerly to Monument 112-5, where we found the P.T.M. and B.T.'s in good condition.

As Papove's line would require some clearing of new brush for chaining, although the targets at the monuments were intervisible, we decided to chain on the bulldozed road some 35.5 feet west of the cut line. We offset a hub and erected a target over it. Rain prevented star shots, so we returned to camp shortly after 9 p.m.



View up Hay River from lower crossing

Weather—heavy lightning to the south, and quite a lot of rain during the night.

Tuesday 11 At Monument 112-4 we offset a hub some 35.5 feet west to centre of bulldozed road, and put up a target. We then chained along the offset line to the hub opposite Monument 112-5...

We then waited for clouds to clear somewhat, when six azimuth observations were made between two observations for time. The time shots gave a rate of 2 seconds per day for the chronometer.

Got back to camp at 8 p.m. Radio reception nil. Flock of swans going S.E. at 9 p.m. Beautiful display of aurora borealis at bed time. Hay River sluggish and muddy here.

Weather—very warm, 70°.

Wednesday 12 Calculated observations and chainage notes in morning. After lunch George New . . . set a target at Monument 112-3. A heavy shower occurred while he was returning to camp. Then we went to Monument 112-4, set up on stakes driven to frost in muskeg and read angles between Monuments 112-3 and 112-5—finding approximately 5" deflection. Good radio contact with the Beatton River camp. Arranged to move to Petitot River tomorrow.

Weather—cloudy, sky clearing somewhat in p.m.

Thursday 13 Wonderfully clear with light wind when helicopter (Pilot Art Coles) arrived at 11 a.m. . . . Cole and New took off at 11:45 a.m. for Petitot River crossing where a landing was made on the north side of that river. Cole then returned for me. New had camp up when we landed at the Petitot . . . Between the Hay and Petitot Rivers there are bulldozed roads on each side of Papove's boundary line and every 3 to 4 miles in northing, roads running from east to west end at the boundary. In Palsen's area (Monument 118-5 to N.E. corner B.C.) in one stretch of a few miles the line was cleared out by bulldozers. After lunch we proceeded north on foot. A steep climb of 150 feet took us to the plateau, the line from there to Monument 122-2 goes through windfall and brule. It was hard going—crawling over the logs.

Monument 122-2 is in a muskeg, the trench having been cut in peat moss. New proceeded north to Monument 122-3, also located in a muskeg. He erected a signal 7 feet high at Monument 122-3. This was not visible from Monument 122-2, the rise out of muskeg to clay ridge being too great.

Next we placed a target 10 feet high at Monument 122-2, and then went back to camp at 9 p.m. We noticed that centre of mound at Monument 122-2 is 18 inches east of line—suspect line was offset. Palsen's line is well cut out and monumented—blazing scanty.

Weather—good. Radio signals from Beatton River good. Helicopter arrived back at Beatton River O.K.



Petitot River crossing. George New (left) and pilot Art Coles



View south from Monument 112-4

- Friday 14 Due to the hard walking over logs and muskeg, we decided to chain from Monuments 122-1 and 122-2 crossing the Petitot River. At signal 122-1 we could see target at 122-2 but not at Monument 122-3. We put up high signal at 122-1 and chained north to Monument 122-2. We put a hub in hard ground south of Monument 122-2, as an observation station. However, as the sky was cloudy and hazy at observing time, we did not get any star shots. Returned to camp at 9:15 p.m. We had good radio reception at morning schedule, but got back to camp too late for evening schedule.

Notes about Palsen's Line

Blazing scanty but line cut wide and clear. Down logs and muskegs make travelling hard. Intervisibility between Monuments 122-2 and 122-3 not apparent. Slightly higher ground near each of these stations will allow ranging in with one set up. Apparently monuments put in frozen muskeg, where the trench could be chopped out, while the clay soil on the higher ground, when frozen, would have been very difficult to dig.

- Saturday 15 We worked out chainage from Monuments 122-1 to 122-2, and after checking we had good agreement with Mr. Palsen's work.

Plenty windfall, cut logs and brush north of the river, made chaining somewhat difficult. We looked for control for air photos, but found it difficult with the views we had.

In late afternoon we went to Monument 122-2 and took 6 observations for azimuth and 2 time stars. As it was partly cloudy and hazy we had several waits between observations and quit only when target at 122-1 was hard to see. Reached camp at 10:15 p.m.

- Sunday 16 There was a thunder and lightning storm accompanied by two showers in early morning. We worked out observations and made a tie to a point of control. Had radio contact with McMinn's camp at 8 a.m. and advised them that we would be ready to move again on Monday.

Weather—There was a lot of thunder to the south and rain at 9 p.m.

Monday 17 The sky was overcast, very low in early morning. We were told by radio, country east and north of Beaton River camp was fogged up, at 8 a.m. schedule. It looked poor for the helicopter coming north. However, Pilot Coles took off at 10:15 a.m. and made our camp on the Petitot around 2 p.m. He moved George New over to the gas-cache lake. Then he returned to the Petitot River camp and we proceeded north to Latitude Station X, the tenth of the stations located near the



N. C. Stewart standing over post marking the northeast corner of British Columbia

north boundary of Alberta at which precise observations for latitude were made by the Geodetic Survey of Canada during 1950-51, landing in a muskeg less than 50 feet from the north-east corner of British Columbia. I chained from Latitude Station X to Monument 127-1 at the north-east corner of the province and found everything O.K. . . .

After making some exposures, we took off on the return journey to the Beaton River camp and stops were made at each one of our "up" camps for gassing. We landed at McMinn's camp at 9 p.m. just before dark. . . .

CHAPTER V

CONCLUSION AND RECOMMENDATIONS

The field work having been satisfactorily completed, the subsequent transactions of the Commission were concerned principally with the preparation of final map sheets, the checking of survey returns and the compilation of this report. Meetings of the Commission were held in connection with these matters at Ottawa in September, 1953, and January, 1954, and at Edmonton in September, 1954.

At these meetings, one question which caused the Commission some concern was that of future maintenance of the boundary line. Various reports had been received indicating that some of the boundary monuments erected during the 1913-1925 period, particularly those readily accessible to the public, had been seriously defaced or had become dilapidated through exposure to the elements. There was also an instance in which it was necessary to take prompt steps to ensure the preservation of the position of a monument in the Crowsnest Pass; its removal being necessitated by the extension of strip-mine workings across the boundary. Furthermore, it seemed specially desirable that the more recently surveyed portion of the line should be preserved in good condition both as to monumentation and line clearance, as this portion constitutes almost the sole landmark in the northerly region through which it runs and, as such, is of great importance not only in connection with surveys that may be made by petroleum exploration parties, but also as a navigational reference in connection with air transportation. The costs of future maintenance would be relatively small and the Commission feels that it would be most unfortunate if this boundary line, representing a large capital outlay, were not properly preserved.

Our enquiries as to legal responsibility for maintenance of the boundary have elicited the opinion that once such a line has been delineated on the ground to the satisfaction of the governments concerned, the Canadian Government's interest in the matter ceases. It would therefore appear to rest with the two provinces to make such arrangements as may be appropriate and mutually acceptable for its future preservation. In respect of the Alberta-British Columbia Boundary, it is the view of this Commission that such arrangements should include the establishment of a permanent Boundary Commission on a provincial basis, in order that the responsibility for maintenance may be specifically assigned and be supported by statutory authority for the expenditures required.

The technical examination of the various survey returns and Mr. Stewart's findings on inspection of the boundary indicates to the Commission that the demarcation of that section of the boundary surveyed in the 1950-53 period has

been satisfactorily carried out within the specified limits of accuracy. As the 1913-1924 section of the boundary has already been confirmed by Act of Parliament (22-23 George V, Ch. 5, 1932), the Commission accordingly makes the following recommendations with regard to adoption of the 1950-53 section of the boundary and the future physical preservation of the boundary as a whole:

1. That that portion of the boundary line between the Provinces of Alberta and British Columbia as defined by survey monuments established on the ground in accordance with the instructions of the Alberta-British Columbia Boundary Commission during the years 1950 to 1953 inclusive and as shown on maps numbered 55 to 66 and signed by the members of the Commission be accepted as the true boundary between the said provinces;
2. That each of the governments of the said provinces prepare and submit to their Legislative Assemblies an appropriate bill for an Act consenting to the establishment of the above described boundary line as the true and unalterable boundary between the said Provinces by declaration of the Parliament of Canada;
3. That an agreement be entered into between the governments of the Provinces of Alberta and British Columbia, providing for—
 - (a) the perpetuation of an inter-provincial Boundary Commission consisting of two members, one representing the Province of Alberta and the other representing the Province of British Columbia;
 - (b) the execution, on instructions of the said inter-provincial Boundary Commission, of such re-surveys, line clearing and restorative work as may appear necessary from time to time for the purpose of maintaining the boundary line and the boundary monuments thereon in a good state of preservation, and
 - (c) the appropriation of funds for and the sharing of the costs of the said maintenance work.

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628345
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appointed to delimit the
Report [and Atlases] ?
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